Heathkit

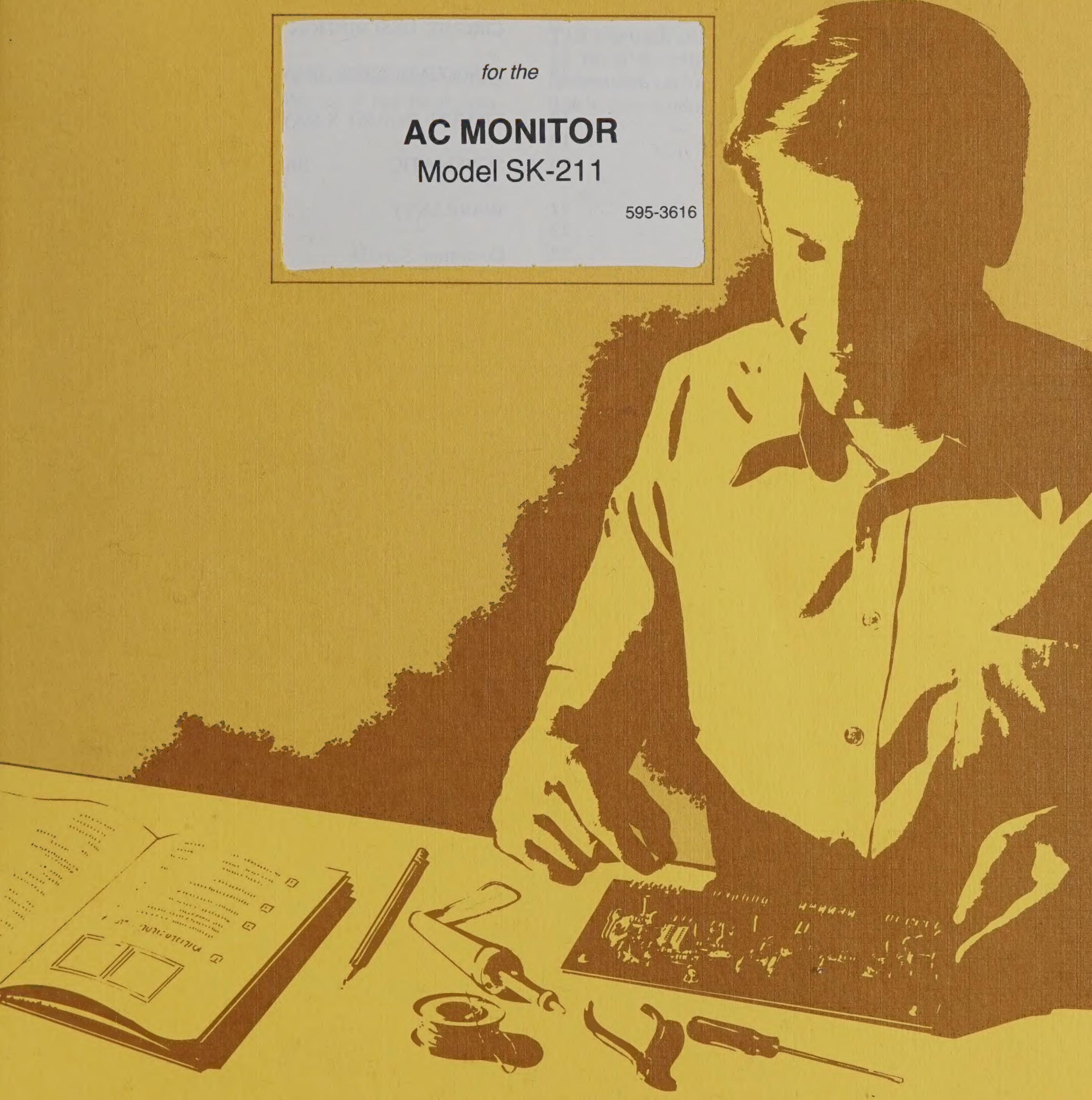
MODEL	SERIES NO.
SK-211	01 62597

HEATHKIT® MANUAL

for the

AC MONITOR
Model SK-211

595-3616



HEATH COMPANY • BENTON HARBOR, MICHIGAN

HEATH COMPANY PHONE DIRECTORY

The following telephone numbers are direct lines to the departments listed:

Kit orders and delivery information	(616) 982-3411
Credit	(616) 982-3561
Replacement Parts	(616) 982-3571

Technical Assistance Phone Numbers
8:00 A.M. to 12 P.M. and 1:00 P.M. to 4:30 P.M., EST, Weekdays Only

Audio	(616) 982-331
Amateur Radio	(616) 982-329
Test Equipment, Weather Instruments and Home Clocks	(616) 982-331
Television	(616) 982-330
Aircraft, Marine, Security, Scanners, Automotive, Appliances and General Products	(616) 982-349
Computers — Hardware	(616) 982-330
Computers — Software:	
Operating Systems, Languages, Utilities	(616) 982-386
Application Programs	(616) 982-388

YOUR HEATHKIT 90-DAY LIMITED WARRANTY

Consumer Protection Plan for Heathkit Consumer Products

Welcome to the Heath family. We believe you will enjoy assembling your kit and will be pleased with its performance. Please read this Consumer Protection Plan carefully. It is a "LIMITED WARRANTY" as defined in the U.S. Consumer Product Warranty and Federal Trade Commission Improvement Act. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Heath's Responsibility

PARTS — Replacements for factory defective parts will be supplied free for 90 days from date of purchase. Replacement parts are warranted for the remaining portion of the original warranty period. You can obtain warranty parts direct from Heath Company by writing or telephoning us at (616) 982-3571. And we will pay shipping charges to get those parts to you . . . anywhere in the world.

SERVICE LABOR — For a period of 90 days from the date of purchase, any malfunction caused by defective parts or error in design will be corrected at no charge to you. You must deliver the unit at your expense to the Heath factory, any Heath/Zenith Computers and Electronics center (units of Veritechnology Electronics Corporation), or any of our authorized overseas distributors.

TECHNICAL CONSULTATION — You will receive free consultation on any problem you might encounter in the assembly or use of your Heathkit product. Just drop us a line or give us a call. Sorry, we cannot accept collect calls.

NOT COVERED — The correction of assembly errors, adjustments, calibration, and damage due to misuse, abuse, or negligence are not covered by the warranty. Use of corrosive solder and/or the unauthorized modification of the product or of any furnished component will void this warranty in its entirety. This warranty does not include reimbursement for inconvenience, loss of use, customer assembly, set-up time, or unauthorized service.

This warranty covers only Heath products and is not extended to other equipment or components that a customer uses in conjunction with our products.

SUCH REPAIR AND REPLACMENT SHALL BE THE SOLE REMEDY OF THE CUSTOMER AND THERE SHALL BE NO LIABILITY ON THE PART OF HEATH FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO ANY LOSS OF BUSINESS OR PROFITS, WHETHER OR NOT FORESEEABLE.

Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

Owner's Responsibility

EFFECTIVE WARRANTY DATE — Warranty begins on the date of first consumer purchase. You must supply a copy of your proof of purchase when you request warranty service or parts.

ASSEMBLY — Before seeking warranty service, you should complete the assembly by carefully following the manual instructions. Heathkit service agencies cannot complete assembly and adjustments that are customer's responsibility.

ACCESSORY EQUIPMENT — Performance malfunctions involving other non-Heath accessory equipment, (antennas, audio components, computer peripherals and software, etc.) are not covered by this warranty and are the owner's responsibility.

SHIPPING UNITS — Follow the packing instructions published in the assembly manuals. Damage due to inadequate packing cannot be repaired under warranty.

If you are not satisfied with our service (warranty or otherwise) or our products, write directly to our Director of Customer Service, Heath Company, Benton Harbor MI 49022. He will make certain your problems receive immediate, personal attention.

Heathkit® Manual

for the

AC MONITOR

Model SK-211

595-3616

CAUTION: TO PREVENT ELECTRICAL SHOCK HAZARD, DO NOT PLUG THE UNIT IN WHILE THE CASE IS REMOVED.

HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

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Table of Contents

INTRODUCTION 3

ASSEMBLY NOTES 4

PARTS LIST 7

STEP-BY-STEP ASSEMBLY 9
Circuit Board Assembly 9
Circuit Board Checkout 17
Assembly Continued 18

TESTS AND CALIBRATION 19
Calibration Test 19
Operational Tests 20

OPERATION 22
AC Line Voltage Waveform 22
Using the Monitor 22

IN CASE OF DIFFICULTY 23
General Troubleshooting Information 23
Troubleshooting Precautions 25
Troubleshooting Chart 25

SPECIFICATIONS 27

CIRCUIT DESCRIPTION 28

SEMICONDUCTOR IDENTIFICATION 32

CIRCUIT BOARD X-RAY VIEW 33

SCHEMATIC . . . . . . Illustration Booklet, Page 11

WARRANTY . . . . Inside front cover

Customer Service . . . . Inside rear cover

INTRODUCTION

The Heathkit Model SK-211 AC Monitor measures and displays the AC voltage that is present at a standard electrical outlet. Eight easy-to-read LEDs (light-emitting diodes) display the voltage in 5-volt steps between 95 and 130 volts AC. If you have an ohmmeter available, you can calibrate the Monitor for an accuracy of ± 3-volts AC (± 5 volts without an ohmmeter).

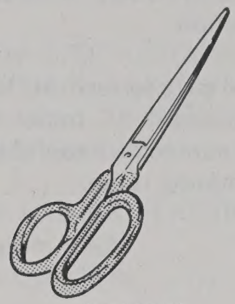
A separate Fault LED lights whenever the AC line voltage drops below 90 volts, or it has been completely interrupted. In addition, a separate Spike LED lights whenever a line voltage transient greater than 200 volts has occurred. Such voltage transients can affect the operation or data validity of computers or other equipment. These LEDs remain lit until you push the front panel Reset button.

This compact, attractive, and easy-to-read AC Monitor plugs directly into a standard AC outlet. It is convenient, accurate, and is sure to be a useful addition to your workshop or computer room.

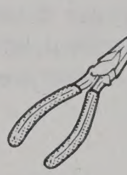
ASSEMBLY NOTES

TOOLS

You will need these tools to assemble your kit.

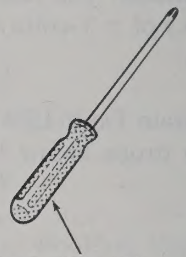


SCISSORS



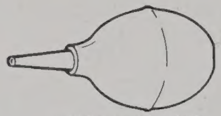
LONG-NOSE PLIERS

DIAGONAL CUTTERS



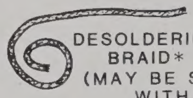
#1 & #2 PHILLIPS SCREWDRIVER

OTHER HELPFUL TOOLS



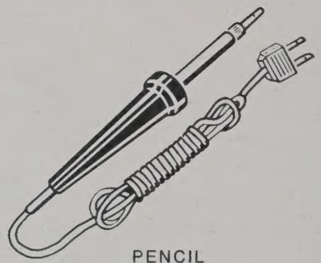
DESOLDERING BULB*

NUT STARTER (MAY BE SUPPLIED WITH KIT)



DESOLDERING BRAID* (MAY BE SUPPLIED WITH KIT)

*TO REMOVE SOLDER FROM CIRCUIT CONNECTIONS



PENCIL SOLDERING IRON (22 TO 25 WATTS)

ASSEMBLY

1. Follow the instructions carefully. Read the entire step before you perform each operation.

2. The illustrations in the Manual are called Pictorials and Details. Pictorials show the overall operation for a group of assembly steps; Details generally illustrate a single step. When you are directed to refer to a certain Pictorial "for the following steps," continue using that Pictorial until you are referred to another Pictorial for another group of steps.

3. Most kits use a separate "Illustration Booklet" that contains illustrations (Pictorials, Details, etc.) that are too large for the Assembly Manual. Keep the "Illustration Booklet" with the Assembly Manual. The illustrations in it are arranged in Pictorial number sequence.

4. Position all parts as shown in the Pictorials.

5. Solder instructions are generally given only at the end of a series of similar steps. You may solder more often if you desire.

6. Each circuit part in an electronic kit has its own component number (R2, C4, etc.). Use these numbers when you want to identify the same part in the various sections of the Manual. These numbers, which are especially useful if a part has to be replaced, appear:

   — In the Parts List,

   — At the beginning of each step where a component is installed,

   — In some illustrations,

   — In Troubleshooting Charts,

   — In the Schematic,

   — In the sections at the rear of the Manual.

7. When you are instructed to cut something to a particular length, use the scales (rulers) provided at the bottom of the Manual pages.

SAFETY WARNING: Avoid eye injury when you cut off excessive lead lengths. Hold the leads so they cannot fly toward your eyes.

SOLDERING

Soldering is one of the most important operations you will perform while assembling your kit. A good solder connection will form an electrical connection between two parts, such as a component lead and a circuit board foil. A bad solder connection could prevent an otherwise well-assembled kit from operating properly.

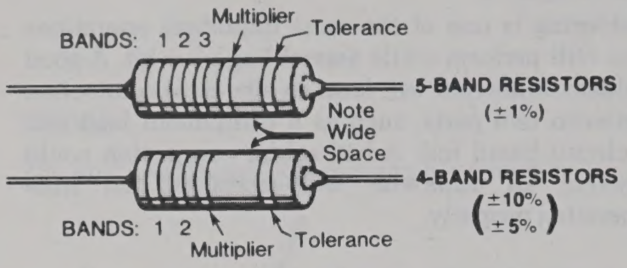
It is easy to make a good solder connection if you follow a few simple rules:

1. Use the right type of soldering iron. A 22 to 25-watt pencil soldering iron with a 1/8" or 3/16" chisel or pyramid tip works best.

2. Keep the soldering iron tip clean. Wipe it often on a wet sponge or cloth; then apply solder to the tip to give the entire tip a wet look. This process is called tinning, and it will protect the tip and enable you to make good connections. When solder tends to "ball" or does not stick to the tip, the tip needs to be cleaned and retinned.

NOTE: Always use rosin core, radio-type solder (60:40 tin-lead content) for all of the soldering in this kit. This is the type we have supplied with the parts. The Warranty will be void and we will not service any kit in which acid core solder or paste has been used.

PARTS



Resistors are identified in Parts Lists and steps by their resistance value in Ω (ohms), kΩ (kilohms), or MΩ (megohms). They are usually identified by a color code of four or five color bands, where each color represents a number. See the "Resistor Color Code" chart. These colors are given in the steps in their proper order (except for the last band, which indicates a resistor's "tolerance"; see the "Resistor Tolerance" chart). You do not need to know the color code.

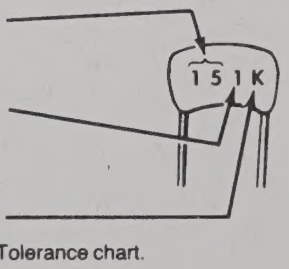
Occasionally, a "precision" or "power" resistor may have the value stamped on it. The letter R, K, or M may also be used at times to signify a decimal point, as in: 2R2 = 2.2 Ω
2K2 = 2.2 kΩ, or 2200 Ω
2M2 = 2.2 MΩ

Precision resistors may also be marked as shown in the following examples. The values of the multipliers are shown in the "Multiplier Chart," and the tolerance values are shown in the "Resistor Tolerance" chart.

Resistor Value — Multiplier — Tolerance

EXAMPLES: 1009C = 100 × 0.1 = 10 Ω, ±0.25%
1001D = 100 × 10 = 1000 Ω, ±0.5%

Capacitors will be called out by their capacitance value in μF (microfarads) or pF (picofarads) and type: ceramic, Mylar®, electrolytic, etc. Some capacitors may have their value printed in the following manner:



First and second digits of capacitor's value: 15

Multiplier: Multiply the first & second digits by the proper value from the "Multiplier Chart."

To find the tolerance of the capacitor, look up this letter in the capacitor Tolerance chart.

RESISTOR COLOR CODE

	Band 1	Band 2	Band 3 (if used)	Multiplier
Color	1st Digit	2nd Digit	3rd Digit	
Black	0	0	0	1
Brown	1	1	1	10
Red	2	2	2	100
Orange	3	3	3	1,000
Yellow	4	4	4	10,000
Green	5	5	5	100,000
Blue	6	6	6	1,000,000
Violet	7	7	7	0.01
Gray	8	8	8	0.1
White	9	9	9	

RESISTOR TOLERANCE

	COLOR OR LETTER	
±10%	SILVER	
± 5%	GOLD	J
± 2%	RED	G
± 1%	BROWN	F
±0.5%	GREEN	D
±0.25%	BLUE	C
±0.1%	VIOLET	B
±0.05%	GRAY	

MULTIPLIER CHART

FOR THE NUMBER:	MULTIPLY BY:	FOR THE NUMBER:	MULTIPLY BY:
0	1	4	10,000
1	10	5	100,000
2	100	8	0.01
3	1000	9	0.1

CAPACITOR TOLERANCE

LETTER	10 pF OR LESS	OVER 10 pF
B	±0.1 pF	
C	±0.25 pF	
D	±0.5 pF	
F	±1.0 pF	±1%
G	±2.0 pF	±2%
H		±3%
J		±5%
K		±10%
M		±20%

EXAMPLES: 151K = 15 × 10 = 150 pF
759 = 75 × 0.1 = 7.5 pF

NOTE: The letter "R" may be used at times to signify a decimal point, as in: 2R2 = 2.2 (pF or μF).

PARTS LIST

Unpack the kit and check each part against the following list. The key numbers correspond to the numbers on the "Parts Pictorial." Do not remove components from the tape strip until you use them in a step. If a part is packed in an individual envelope with the part number on it, identify the part; then return it to the envelope until a step calls for it. Do not throw away any packing material until you account for all of the parts.

To order a replacement part, always include the PART NUMBER. Use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to "Replacement Parts" inside the rear cover of this Manual.

ELECTRONIC COMPONENTS

OK

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
A1	6-470-1	2	47 Ω, 1-watt, 5% (yel-viol-blk-gold) resistor	R1, R2
A2	25-880	1	10 μF electrolytic capacitor	C3
A2	25-883	1	47 μF electrolytic capacitor	C2
A3	27-225	1	.01 μF (103) Mylar capacitor	C8
A4	27-90	1	2.2 μF polystyrene capacitor	C1
A5	64-946	1	Pushbutton switch	SW1
A6	412-654	10	LED (light-emitting diode)	V1, V2, V3, V4, V5, V6, V7, V8, V9, V11

NOTES:

1. Transistors and integrated circuits (ICs) may be marked for identification in any one of the following four ways:
    a. Part number.
    b. Type number. (For integrated circuits, this refers only to the numbers and letters shown in **BOLD** print. Disregard any other numbers or letters shown on the IC.)
    c. Part number and type number.
    d. Part number with a type number other than the one shown.

Electronic Components (Cont'd.)

2. Some integrated circuits can be damaged by static electricity and are packed in conductive foam. Do not remove these ICs from the conductive foam until a step directs you to do so.

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
A7	417-875	3	2N3904 transistor	Q1, Q2, Q3
A7	442-772	1	LM**317**L integrated circuit	U1
A8	442-798	1	LM**3914**N integrated circuit	U2
A8	443-603	1	CD**4011**AE integrated circuit	U3

OK

HARDWARE

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
B1	250-1479	4	#4 × 3/4" self-tapping screw	
B2	250-1280	2	6-32 × 3/8" screw	
B3	252-3	2	6-32 nut	
B4	254-6	4	#6 external-tooth lockwasher	

OK

SOCKETS

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
C1	432-134	10	Wire socket (includes one extra)	
C2	434-298	1	14-pin IC socket	
C2	434-310	1	18-pin IC socket	

OK

PRINTED MATERIAL

OK

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
D1	390-2915	1	Model label* ✓	
D2		1	Blue and white label* ✓	
	597-260	1	Parts Order Form* ✓	
		1	Assembly Manual (See Page 1 for the part number.) ✓	

MISCELLANEOUS

OK

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
E1	75-886	1	Insulator paper (3/4″ × 3″ approx.) ✓	

Miscellaneous (Cont'd.)

OK

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
	85-3182-1	1	Circuit board ✓	
E2	92-877-1	1	Case ✓	
E3	92-878	4	Spacer ✓	
E4	205-1692	1	Back cover ✓	
E5	266-901	1	Narrow AC prong ✓	
E6	266-981	1	Wide AC prong ✓	
	340-17	12″	Bare wire ✓	
	346-78	6″	Sleeving ✓	
E7	462-1217	1	Knob ✓	
E8	490-111	1	IC lifter ✓	
E9	490-185	1	Desoldering braid ✓	
			Solder ✓	

TAPED COMPONENT CHART

NOTE: These parts are taped on a strip that was checked before shipment. Since these parts are taped in the order of assembly, it is not necessary to check them against the following list.

RESISTORS

The following resistors are rated at 1/4-watt and have a tolerance of 5% unless otherwise listed. 5% resistors have a gold fourth color band.

All color-coded 1% and 1/4% resistors have five color bands (last band brown for 1% and blue for 1/4%). The last brown or blue band is set apart from the other bands.

KEY No.	HEATH Part No.	QTY	DESCRIPTION	CIRCUIT Comp. No.
	6-561-12	1	560 Ω (grn-blu-brn)	R16
	6-1001-12	3	1000 Ω, 1% (brn-blk-blk-brn)	R3, R13, R14
	6-1431-12	1	1430 Ω, 1% (brn-yel-org-brn)	R15
	6-332-12	2	3300 Ω (org-org-red)	R22, R24
	6-562-12	2	5600 Ω (grn-blu-red)	R18, R19
	6-4991-12	1	4990 Ω, 1% (yel-wht-wht-brn)	R CAL
	6-5901-12	1	5900 Ω, 1% (grn-wht-blk-brn)	R CAL
	6-7151-12	1	7150 Ω, 1% (viol-brn-grn-brn)	R CAL
	6-9091-12	1	9090 Ω, 1% (wht-blk-wht-brn)	R CAL
	6-1212-12	1	12.1 kΩ, 1% (brn-red-brn-red)	R4
	6-153-12	1	15 kΩ (brn-grn-org)	R25
	2-770-12	1	25 kΩ, 1/4% (red-grn-blk-red)	R8
	6-333	3	33 kΩ, 1/2-watt (org-org-org)	R9, R11, R12
	6-6812-12	1	68.1 kΩ, 1% (blu-gry-brn-red)	R5

Resistors (Cont'd.)

KEY No.	HEATH Part No.	QTY	DESCRIPTION	CIRCUIT Comp. No.
	6-104-12	5	100 kΩ (brn-blk-yel)	R21, R23, R27, R28, R29
	2-767-12	2	250 kΩ, 1/4% (red-grn-blk-org)	R6, R7
	6-105-12	1	1 MΩ (brn-blk-grn)	R17
	6-335-12	1	3.3 MΩ (org-org-grn)	R26

CAPACITORS

KEY No.	HEATH Part No.	QTY	DESCRIPTION	CIRCUIT Comp. No.
	21-786	5	.1 µF (104) axial-lead ceramic	C4, C5, C6, C7, C9

DIODES

KEY No.	HEATH Part No.	QTY	DESCRIPTION	CIRCUIT Comp. No.
	56-32	2	13.5-volt zener	D1, D2
	56-48	2	110-volt zener	D7, D9
	56-56	3	1N4149	D11, D12, D13
	56-85	2	5-volt zener, 1%	D4, D5
	56-93	2	FD-333	D6, D8
	57-27	1	1N5397	D3

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*These items may be packed inside the Manual.

STEP-BY-STEP ASSEMBLY

CIRCUIT BOARD ASSEMBLY

Refer to Pictorial 1-1 while you read the following notes and steps.

NOTES:

1. Many circuit board drawings, such as the one shown in Pictorial 1-1, are divided into two or more sections. You will be working on each of these sections in a specific series of steps.
2. In each series of steps, you will install parts in a top-to-bottom, left-to-right sequence. Occasionally, you may be directed to install a part out of sequence.
3. Check off each step as you perform it. You may also wish to place a check mark near each component on the Pictorial as you install it.
4. In general, solder instructions are given only at the end of a series of similar steps. You may solder more often if you wish.

(✓) Cut the "Taped Component Chart" from the last page in the Illustration Booklet. Make sure you read the instructions at the top of the chart before you use it. Note that it is divided into numbered sections which correspond to the numbered sections on the circuit board pictorial. The components are listed in the order of assembly.

In the following steps, you will be given detailed instructions on how to install and solder the first part on the circuit board. Read and perform each step carefully. Then use the same procedure to install the other parts on the circuit board.

Note that the circuit board has foil patterns on one side and the other side has outlines of components (parts) shown on it. The "foil" side of the board will be referred to as such, and the side with the outlines will be called the "component" side of the board.

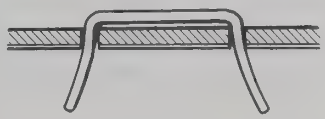
Section 1

(✓) Position the circuit board as shown in the Pictorial with the component side facing up. Then install the first part as described in the following steps.

NOTE: When a step calls for bare wire, use the wire supplied with the kit. Cut it to the indicated length and install it as you are directed in the step.

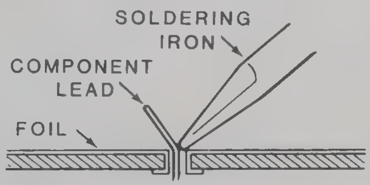
(✓) Cut a 3/4" bare wire. Then bend the wire to fit into the circuit board holes at W1.

(✓) Press the wire against the circuit board. Then bend the ends outward slightly to hold it in place.

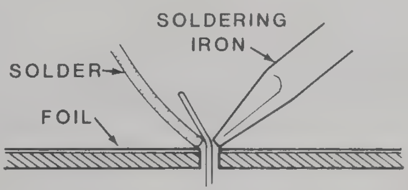


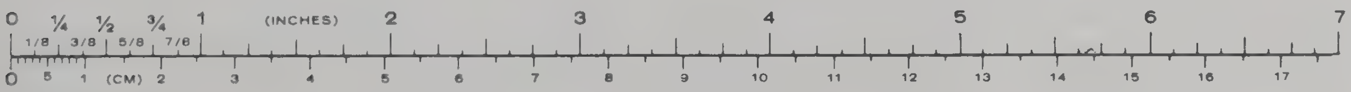
(✓) Use the following procedure to solder the wire to the circuit board:

1. Push the soldering iron tip against both the wire and the circuit board foil. Heat **both** for two or three seconds.

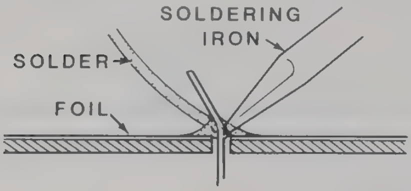


2. Apply solder to the other side of the connection. IMPORTANT: Let the heated wire and the circuit board foil melt the solder.





3. As the solder begins to melt, allow it to flow around the connection. Then remove the solder and the iron and let the connection cool.



NOTE: If you should accidentally fill a nearby circuit board hole with solder and wish to clear it, use the desoldering braid supplied with your kit for this purpose. The instructions are printed on the package.

(✓) Cut off the excess wire ends close to the connection. WARNING: Clip the wires so the ends will not fly toward your eyes.

(✓) Check each solder connection and compare it to Detail 1-1A. After you have checked the connections, proceed with the assembly. Use the same soldering procedure for each component.

IMPORTANT: Make sure you installed the first part (a wire) on Page 9 before you proceed.

(✓) Cut the following lengths of bare wire and sleeving. NOTE: You will use these wires and sleeving in the next two steps.

1-1/2″ bare wire	1″ sleeving
1-3/4″ bare wire	1-1/4″ sleeving

NOTE: When you install the wires in the next two steps, be sure to use the correct circuit board holes as shown in the Pictorial. Also be sure to route the wires across the circuit board as shown in the Pictorial.

(✓) W3: Slide a 1″ length of sleeving onto a 1-1/2″ bare wire. Then connect the wire between the two circuit holes labeled "W3."

(✓) W4: Slide a 1-1/4″ length of sleeving onto a 1-3/4″ bare wire. Then connect the wire between the two circuit board holes labeled "W4."

(✓) Solder the wire ends to the foil and cut off any excess wire ends.

Section 2

(✓) Cut the following lengths of wire and sleeving:

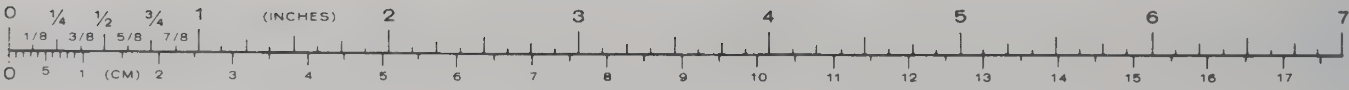
1-1/2″ bare wire	3/4″ bare wire
1-1/8″ bare wire	1″ sleeving

(✓) W5: Slide a 1″ length of sleeving onto a 1-1/2″ bare wire. Then connect the wire between the two circuit holes labeled "W5."

(✓) W6: Connect the 1-1/8″ bare wire between the holes labeled "W6."

(✓) W2: Install the 3/4″ bare wire in the circuit board at "W2."

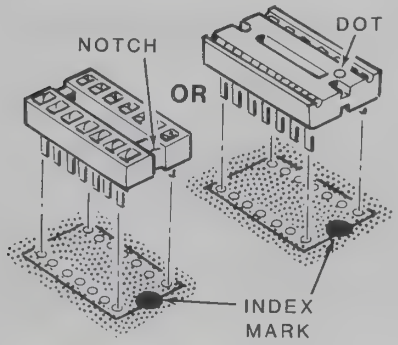
(✓) Solder the wire ends to the foil and cut off any excess wire ends.


0 ¼ ½ ¾ 1 (INCHES) 2 3 4 5 6 7
1/8 3/8 5/8 7/8
0 5 1 (CM) 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

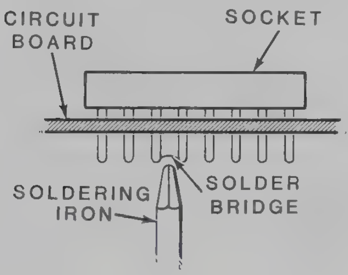
Refer to Pictorial 1-2 while you perform the following steps.

NOTES:

1. In some of the following steps, you will be directed to install IC sockets. Before you install each IC socket, make sure the pins are straight. If there is any kind of identification mark (notch, dot, arrowhead, etc.) at or near one end of the socket, position this marked end toward the index mark on the circuit board (this index mark should still be visible after you install the socket). Then start the pins into the circuit board holes and solder them to the foil.



2. It is very easy to form an unwanted solder bridge between foils when you install an IC socket. After you install each socket, carefully inspect the foil for solder bridges and remove any that you find, as shown below. If you suspect that you have a solder bridge, but are not positive, you can check your foil pattern against the one shown in the "X-Ray View" on Page 33.



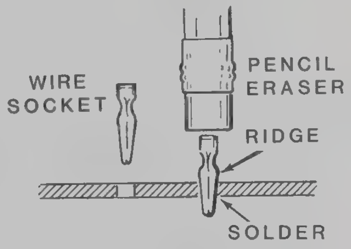
Section 1

(✓) 18-pin IC socket at U2.

Section 2

(✓) 14-pin IC socket at U3.

NOTE: When a step directs you to install a wire socket, push the tapered end of the socket as far as possible into the circuit board hole (you may wish to use the eraser end of a pencil to help push the socket into the hole). Then turn the circuit board over and solder the socket to the foil. Try not to fill the socket with solder.



Section 1

(✓) Two wire sockets at J1.

(✓) Wire socket at S5.

(✓) Wire socket at S4.

(✓) Wire socket at S3.

(✓) Wire socket at S2.

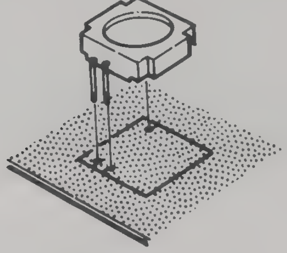
(✓) Wire socket at S1.

Section 2

(✓) Two wire sockets at J2.

(✓) Push a straight pin (not supplied) into each of the nine wire sockets to prestretch them. This will make it easier to push a wire into them later.

(✓) SW1: Pushbutton switch (#64-946). Start the three switch pins into their corresponding circuit board holes. Then push the switch down tight against the circuit board and solder the pins to the foil. NOTE: You may wish to use a pencil, or something similar, to hold the switch against the circuit board while you solder the pins.

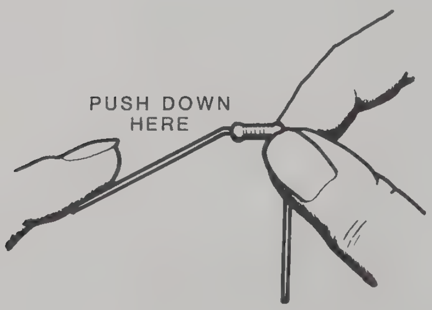


NOTE: The components that you will install in the next two Pictorials are on the "Taped Component Chart."

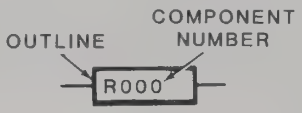
Refer to Pictorial 1-3 while you perform the following steps.

Section 1

( ) Cut the first component, a 68.1 kΩ, 1% (blu-gry-brn-red) resistor, from the Taped Component Chart as outlined in the instructions. Then hold the resistor by the body as shown and bend the leads straight down with your finger to fit the circuit board hole spacing.



(✓) R5: Start the resistor leads into their circuit board holes at the resistor's location in the circuit board. The end with the color bands may be positioned either way. Press the resistor body against the circuit board and bend the leads outward slightly to hold it in place. NOTE: Resistors are identified on the circuit board by the following outline:



(✓) R9: 33 kΩ, 1/2-watt (org-org-org) resistor.

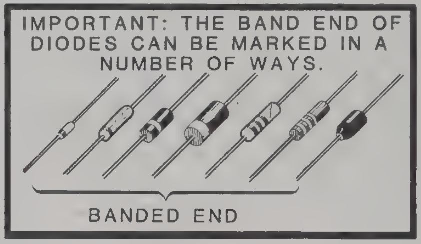
(✓) R11: 33 kΩ, 1/2-watt (org-org-org) resistor.

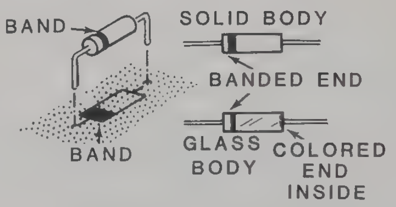
( ) R12: 33 kΩ, 1/2-watt (org-org-org) resistor.

NOTES:

1. In some of the following steps, you will install diodes. Whenever you install a diode, always match the banded end of the diode with the band mark on the circuit board. The circuit will not work properly if the diode is installed backwards.

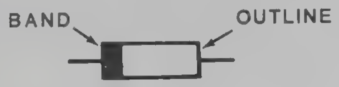
2. The banded end of diodes will always be positioned toward the colored tape on the "Taped Component Chart."


IMPORTANT: THE BAND END OF DIODES CAN BE MARKED IN A NUMBER OF WAYS.
BANDED END



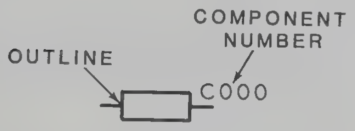
CAUTION: ALWAYS POSITION THE BANDED END OF A DIODE AS SHOWN ON THE CIRCUIT BOARD.

(✓) D6: FD-333 diode (#56-93). NOTE: Diodes in this Pictorial are identified on the circuit board by the following outline:



(✓) R8: 25 kΩ, 1/4% (red-grn-blk-red) resistor.

(✓) C7: .1 μF (104) axial-lead ceramic capacitor. NOTE: Axial-lead ceramic capacitors are identified on the circuit board by the following outline:



(✓) Solder the leads to the foil and cut off the excess lead lengths.

Section 2

(✓) C6: .1 μF (104) axial-lead ceramic capacitor.

(✓) C4: .1 μF (104) axial-lead ceramic capacitor.

(✓) C5: .1 μF (104) axial-lead ceramic capacitor.

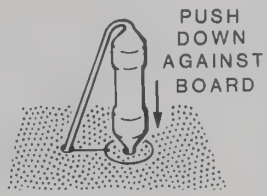
(✓) C9: .1 μF (104) axial-lead ceramic capacitor.

(✓) D13: 1N4149 diode (#56-56). Be sure to match the banded end of the diode with the band mark on the circuit board.

(✓) Solder the leads to the foil and cut off the excess lead lengths.

Refer to Pictorial 1-4 while you perform the following steps.

NOTE: Mount all of the resistors in this Pictorial **vertically** as shown below.

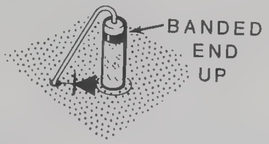


Section 1

(✓) R6: 250 kΩ, 1/4% (red-grn-blk-org) resistor.

(✓) R7: 250 kΩ, 1/4% (red-grn-blk-org) resistor.

NOTE: Mount all of the diodes in this Pictorial **vertically** as shown below. Be sure to position the banded end of the diode up away from the circle part of the outline.



(✓) D8: FD-333 diode (#56-93).

(✓) R18: 5600 Ω (grn-blu-red) resistor.

NOTE: do not cut the next two diodes from the tape strip. Pull them from the strip to make sure the leads are long enough for proper installation. (Be sure there is no gum residue on the leads.)

(✓) D7: 110-volt zener diode (#56-48).

(✓) D9: 110-volt zener diode (#56-48).

(✓) Solder the leads to the foil and cut off the excess lead lengths.

Section 2

- ☑ D11: 1N4149 diode (#56-56).
- ☑ R25: 15 kΩ (brn-grn-org) resistor.
- ☑ R26: 3.3 MΩ (org-org-grn) resistor.
- ☑ R17: 1 MΩ (brn-blk-grn) resistor.
- ☑ R19: 5600 Ω (grn-blu-red) resistor.
- ☑ R22: 3300 Ω (org-org-red) resistor.
- ☑ Solder the leads to the foil and cut off the excess lead lengths.

Section 3

- ☑ R13: 1000 Ω, 1% (brn-blk-blk-brn) resistor.
- ☑ R27: 100 kΩ (brn-blk-yel) resistor.
- ☑ R14: 1000 Ω, 1% (brn-blk-blk-brn) resistor.
- ☑ R15: 1430 Ω, 1% (brn-yel-org-brn) resistor.
- ☑ Solder the leads to the foil and cut off the excess lead lengths.
- ☑ D12: 1N4149 diode (#56-56).
- ☑ R23: 100 kΩ (brn-blk-yel) resistor.
- ☑ R21: 100 kΩ (brn-blk-yel) resistor.
- ☑ R24: 3300 Ω (org-org-red) resistor.
- ☑ Solder the leads to the foil and cut off the excess lead lengths.

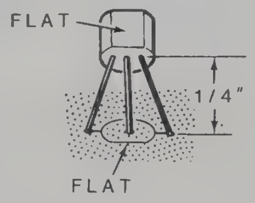
Section 4

- ☑ R16: 560 Ω (grn-blu-brn) resistor.
- ☑ D3: 1N5397 diode (#57-27).
- ☑ D1: 13.5-volt zener diode (#56-32).
- ☑ D2: 13.5-volt zener diode (#56-32).
- ☑ D4: 5-volt zener diode (#56-85).
- ☑ D5: 5-volt zener diode (#56-85).
- ☑ Solder the leads to the foil and cut off the excess lead lengths.
- ☑ R4: 12.1 kΩ, 1% (brn-red-brn-red) resistor.
- ☑ R28: 100 kΩ (brn-blk-yel) resistor.
- ☑ R3: 1000 Ω, 1% (brn-blk-blk-brn) resistor.
- ☐ R29: 100 kΩ (brn-blk-yel) resistor.
- ☑ Solder the leads to the foil and cut off the excess lead lengths.
- ☑ Cut the remaining four resistors from the tape strip and set them aside. They will be called for later.

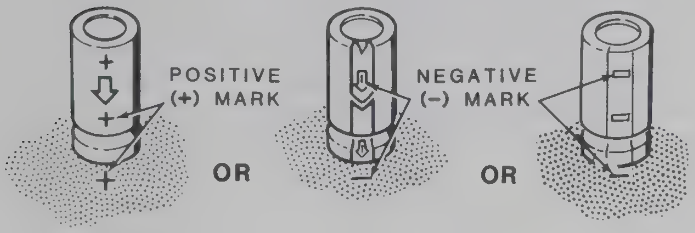
Refer to Pictorial 1-5 while you perform the following steps.

Section 1

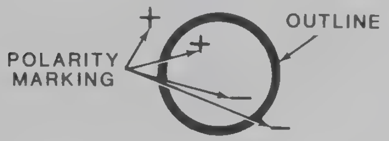
- ☑ C8: .01 μF (103) Mylar capacitor. Solder the leads to the foil and cut off the excess lead lengths.
- ☑ U1: LM317L integrated circuit (#442-772). Position the IC so the flat side is over the outline of the flat on the circuit board. Then start the leads into the corresponding holes in the circuit board. Position the IC 1/4" above the circuit board. Then solder the leads to the foil and cut off any excess lead lengths.



NOTE: Before you install an electrolytic capacitor, look at it and identify the leads. One lead will have a positive (+) mark or a negative (−) mark near it. Be sure to install the positive lead in the positive-marked hole, or the negative lead in the negative-marked hole. Solder the leads to the foil and cut off the excess lead lengths.



(✓) C2: 47 μF electrolytic capacitor. NOTE: Electrolytic capacitors are identified on the circuit board by the following outline:



Section 2

NOTE: Use the same procedure to install the following transistors that you used to install the IC in Section 1. Solder the leads of each transistor to the foil as you install it and cut off any excess lead lengths.

(✓) Q1: 2N3904 transistor (#417-875).

(✓) Q2: 2N3904 transistor (#417-875).

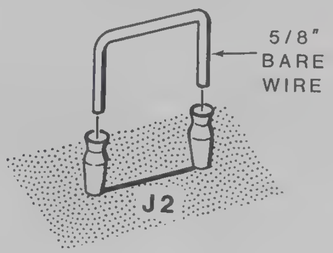
(✓) Q3: 2N3904 transistor (#417-875).

(✓) C3: 10 μF electrolytic capacitor. Solder the leads to the foil and cut off the excess lead lengths. NOTE: Be sure to observe the proper polarity.

Refer to Pictorial 1-6 while you read the following steps.

(✓) Cut two 5/8" bare wires. Use these wires in the next two steps.

(✓) J2: Form a 5/8" bare wire into a "U" so that it will fit into the wire sockets on the circuit board at J2. Then push the wire as far as possible into the sockets. Use long-nose pliers to hold the wire so you do not damage the wire sockets. NOTE: **DO NOT** solder the wire to the sockets.

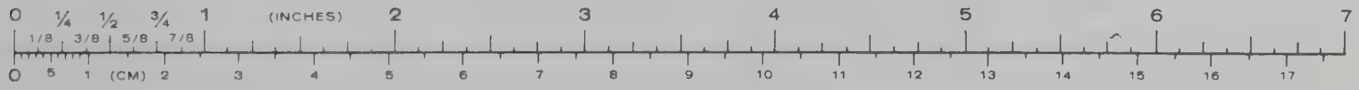


(✓) J1: Similarly form a 5/8" bare wire into a "U" and push it into the wire sockets on the circuit board at J1. Do not solder the wire to the sockets.

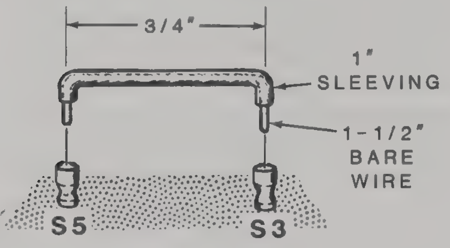
NOTE: The ICs used in some kits are CMOS (complementary metal-oxide semiconductor) devices. These are rugged and reliable components when they are installed, but they can be damaged by static electricity during installation. Other ICs are of a type that is not susceptible to static electricity. Nevertheless, you should treat all ICs as if they were CMOS types, since this will avoid all possible confusion between ICs and provide protection in all cases. Use the procedure shown in Detail 1-6A whenever you are directed to install ICs.

(✓) U2: LM3914N integrated circuit (#442-798).

(✓) Cut a 1-1/2" bare wire and a 1" length of sleeving. Use this wire and sleeving in the next step.



(✓) Slide a 1" length of sleeving onto a 1-1/2" bare wire. Form the wire and sleeving into a "U" so it can fit into the wire sockets on the circuit board at S5 and S3. Then push the wire as far as possible into the sockets. Do not solder the wire to the sockets.

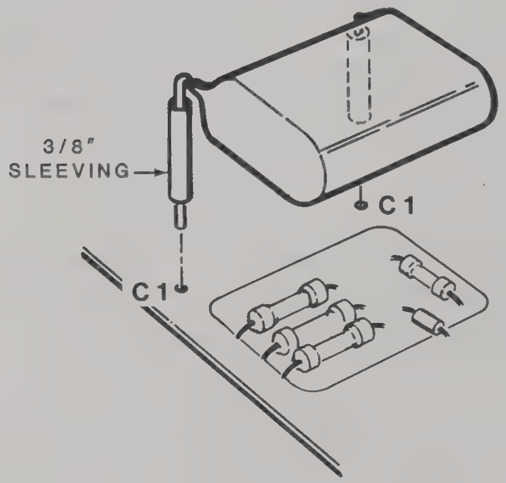


(✓) U3: CD4011AE integrated circuit (#443-603). Be sure to position the pin 1 end of the IC toward the index mark on the circuit board.

Refer to Pictorial 1-7 while you perform the following steps.

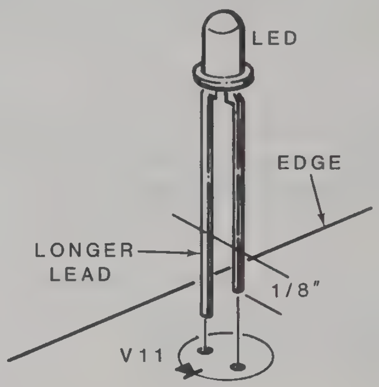
(✓) Cut two 3/8" lengths of sleeving. Use these lengths of sleeving in the next step.

(✓) C1: Bend both leads of a 2.2 μF polystyrene capacitor straight down as shown below. Slide a 3/8" length of sleeving onto each lead. Then start the leads into the circuit board holes labeled "C1." Position the capacitor neatly above the other circuit board components that are within its outline. Then solder the leads to the foil and cut off the excess lead lengths.



(✓) Cut the insulator paper 1" from one end so you have a piece 1" long and a piece 2" long. You will use these insulators as spacers in the following steps.

(✓) V11: Locate one of the light-emitting diodes (LEDs) and notice that one lead is longer than the other. Start the leads of the LED into the circuit board holes at V11 so the **longer lead** is **toward** the nearby edge of the circuit board. At a point 1/8" from the end of the **shorter** LED lead, bend the lead 90° so the LED cannot fall out of the circuit board. Do not solder the leads to the foil yet.



Use the same procedure to install LEDs at the following seven circuit board locations. Be sure to install each LED so its longer lead is toward the nearby edge of the circuit board.

(✓) V9.

(✓) V8.

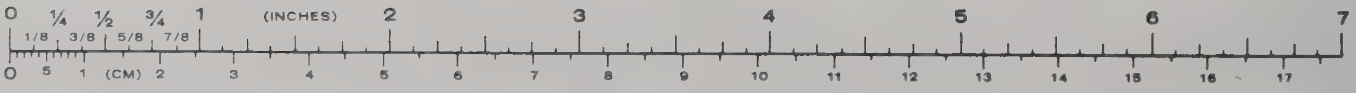
(✓) V7.

(✓) V6.

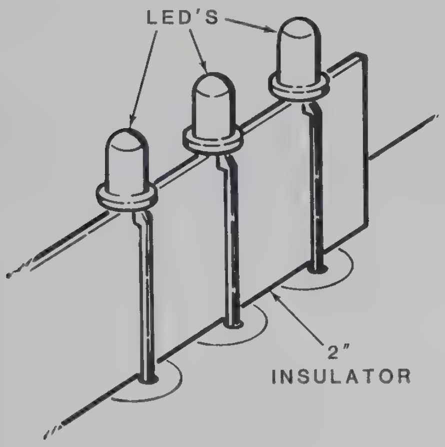
(✓) V5.

(✓) V4.

(✓) V3.



(✓) Slide the 2″ long insulator between the leads of the eight LEDs. Hold the insulator in place while you carefully seat each LED down against the insulator. Be sure the LEDs are all perpendicular to the circuit board. Then rebend the LED leads on the foil side slightly to hold the LEDs in place at the proper distance away from the circuit board. Solder one lead of each LED to the foil. Then check each LED to make sure it is still perpendicular to the circuit board. Reheat the lead and reposition any LED as necessary. Then solder the remaining lead of each LED to the foil and cut off the excess lead lengths.



Use the same procedure you used earlier to install LEDs at the following two locations. NOTE: This time, install each LED so the **shorter** lead is **toward** the nearby edge of the circuit board. Do not solder the leads to the foil yet.

(✓) V2.

(✓) V1.

(✓) Slide the 1″ long insulator between the two LEDs. Hold the insulator in place while you carefully seat each LED down against the insulator. Be sure the LEDs are perpendicular to the circuit board. Then rebend the LED leads slightly to hold the LEDs at the proper distance away from the circuit board. Solder the leads to the foil and cut off the excess lead lengths.

(✓) Carefully slide both of the insulators out from between the LEDs. Save the 2″ insulator for use later; you may discard the 1″ insulator.

NOTE: Be careful during the remainder of the assembly that you do not bend the LEDs. OK

(✓) Refer to Detail 1-7A and position the knob over the pushbutton switch as shown. Then push the knob down onto the switch until it snaps into place.

CIRCUIT BOARD CHECKOUT

NOTE: Some parts will be mounted on the foil side of the circuit board later. For this reason, you should make the following visual checks as carefully as possible.

Carefully inspect the foil side of the circuit board for the following most-commonly-made errors:

(✓) Unsoldered connections. There are two holes, labeled "1" and "2" on the foil side that will be used later.

(✓) Poor solder connections.

(✓) Solder bridges between foil patterns. If you wish, you can check your foil pattern against the one shown in the "X-Ray View" on Page 33.

(✓) Protruding leads which could touch together.

Refer to the illustrations where parts were installed as you make the following visual checks:

(✓) Electrolytic capacitors for the correct position of the positive (+) or negative (−) marked lead.

(✓) Diodes for the proper **type** and **installation**. NOTE: The banded end of each vertically-mounted diode should be away from the circuit board.

(✓) Transistors and integrated circuit U1 for the proper **type** and **installation**. NOTE: The flat sides of these components should all be facing the same direction.

(✓) Integrated circuits U2 and U3 for the proper **type** and **installation**. Make sure no leads are bent out or under the IC.

ASSEMBLY CONTINUED

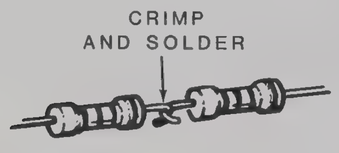
Refer to Pictorial 1-8 while you perform the following steps.

(✓) Position the circuit board with the foil side up as shown in the Pictorial.

(✓) Locate the 2" insulator set aside earlier. Then cut the insulator to a length of 1-1/2".

(✓) Carefully peel away the backing paper from the insulator. Form the insulator into a shallow channel so the sticky side is out. Then press the insulator onto the foil side of the circuit board so it is centered between the holes labeled "1" and "2."

(✓) Cut the leads of both 47 Ω, 1-watt (yel-viol-blk-gold) resistors to 1/4". Form the lead at one end of each resistor into a small hook. Connect the hooks together. Then crimp and solder the connection.



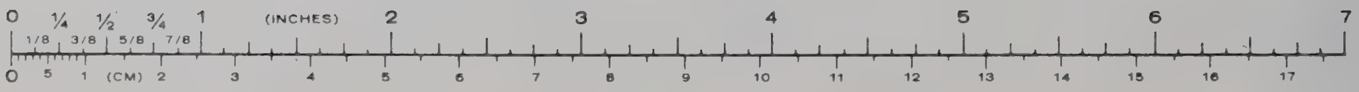
(✓) R1/R2: Connect and solder the prepared resistor combination between the two holes on the foil side of the circuit board labeled "1" and "2." Then cut off any excess lead length on the component side of the circuit board.

NOTE: When you perform the next two steps, you may find it necessary to position capacitor C1 out of the way. Be sure to return the capacitor to its proper position when you finish.

(✓) Mount the **wide** AC prong onto the foil side of the circuit board at AA. Use a 6-32 × 3/8" screw, two #6 external-tooth lockwashers, and a 6-32 nut. Be sure to install a lockwasher on each side of and against the circuit board. Also be sure to position the prong as shown in the Pictorial.

(✓) Similarly mount the **narrow** AC prong onto the foil side of the circuit board at AB. Be sure to position the prong as shown in the Pictorial.

This completes the assembly of the circuit board. Save the remaining parts for use later.


0 ¼ ½ ¾ 1 (INCHES) 2 3 4 5 6 7
1/8 3/8 5/8 7/8
0 5 1 (CM) 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

TESTS AND CALIBRATION

WARNING: Dangerous voltages are present in the AC Monitor when it is connected to an AC outlet. This voltage can cause serious injury or death. Under no circumstances should you operate the AC Monitor with the case and/or back cover removed. Do not plug the AC Monitor into an AC outlet until a step specifically directs you to do so.

This section of the Manual includes a test that can improve the accuracy of the AC Monitor. It also contains a series of steps that will determine if the major circuit areas are operational. If you do not obtain the correct results, first recheck the steps; then, if necessary, refer to the "In Case of Difficulty" section for troubleshooting information.

CALIBRATION TEST

Integrated circuit U2 contains a resistance circuit which can vary over a wide range. This variation has some effect upon the accuracy of the AC Monitor. The following test shows you how to determine this internal resistance, so you can choose an external compensating resistor to improve the accuracy. This test should also be repeated if you ever find it necessary to replace U2.

To perform the following test, you need either an analog (meter display) or a digital ohmmeter to measure U2's internal resistance. If you have such an ohmmeter, or can borrow one, perform the steps under "Selected Value." If no ohmmeter is available, perform the steps under "Default Value."

Selected Value

Refer to Pictorial 2-1 while you perform the following steps.

(✓) Temporarily remove the jumper wire connected between wire sockets S3 and S5.

(✓) If there is a resistor connected between the wire sockets at RCAL, remove it.

(✓) Set your ohmmeter so that it can accurately measure resistance between 6000 and 15 kΩ with good resolution. NOTE: You can measure the value of the 9090 Ω, 1% (wht-blk-wht-brn) resistor supplied with the kit to check the meter's accuracy. If you observe any error in the measurement, use the amount of error as a correction factor in the following steps.

(✓) Connect either ohmmeter lead to wire socket S3. Connect the other ohmmeter lead to wire socket S4 and carefully note the meter indication. Write the indication on the following line: ________.

(✓) Refer to the following table and, depending upon the indication you obtained in the above step, select the proper compensation resistor.

Measured Resistance Range (in ohms)	Compensation Value (in ohms)
6000 to 7700	4990 (yel-wht-wht-brn)
7701 to 9200	5900 (grn-wht-blk-brn)
9201 to 11.3 k	7150 (viol-brn-grn-brn) ✓
11.3 k to 15 k	9090 (wht-blk-wht-brn)

(✓) Cut both leads of the selected compensation resistor to 3/8". Then form the leads to fit into the wire sockets at RCAL.

(✓) RCAL: Carefully push the leads of the prepared resistor into wire sockets at RCAL. Use long-nose pliers to help avoid damage to the wire sockets.

(✓) Locate the 1-3/4" jumper wire (with sleeving) that you set aside earlier. Then carefully reinstall the jumper wire into wire sockets S3 and S5. Use long-nose pliers to help avoid damage to the wire sockets.

NOTE: Save the three leftover resistors for future use, in case you ever find it necessary to replace integrated circuit U2.

Proceed directly to "Operational Checks."

Default Value

Refer to Pictorial 2-1 while you perform the following steps.

( ) If there is a resistor connected between the wire sockets at RCAL, remove it.

( ) Cut both leads of a 7150 Ω, 1% (viol-brn-grn-brn) resistor to 3/8". Then form the leads to fit into the wire sockets at RCAL.

( ) RCAL: Carefully push the leads of the prepared resistor into wire sockets at RCAL. Use long-nose pliers to help avoid damage to the wire sockets.

NOTE: Save the three leftover resistors for future use, in case you ever find it necessary to replace integrated circuit U2 or if you should ever have access to an ohmmeter (so you can perform the steps under "Selected Value").

OPERATIONAL TESTS

In the following steps you will be directed several times to install the circuit board in the case, make a test, and then remove the circuit board from the case. This procedure provides the best protection against accidental contact with the dangerous voltages within the AC Monitor when it is plugged into an AC outlet. **Do not short-cut any of the steps.**

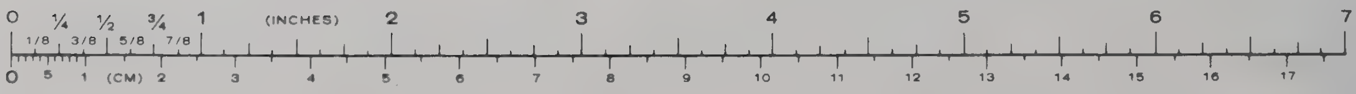
Refer to Pictorial 2-2 while you perform the following steps.

(✓) Temporarily remove the jumper wires connected between the wire sockets at J1 and J2. You will reinstall these jumper wires later.

Refer to Pictorial 2-3 while you perform the following steps.

(✓) Use the following procedure to install the circuit board in the case:

1. Make sure all the LEDs are perpendicular to the circuit board and their leads are straight.
2. Set the circuit board into the case so the LEDs and the pushbutton switch knob extend through their corresponding holes.
3. Push the smaller end of a spacer into each of the circuit board mounting holes.
4. Start the AC prongs into the slots in the back cover. Then set the cover into the case. Use four #4 × 3/4" self-tapping screws to secure the cover to the case. Do not overtighten these screws.



CAUTION: If you do not obtain the indicated results in the next step, immediately unplug the AC Monitor and refer to the "In Case of Difficulty" section for troubleshooting information. Be sure to locate and correct the problem before you continue.

(✓) Plug the AC Monitor into a 120-volt (nominal) AC outlet. The SPIKE and FAULT LEDs should both light.

(✓) Unplug the AC Monitor and remove the circuit board from the case.

(✓) Reinstall one of the jumper wires removed earlier in the wire sockets at J2. Use long-nose pliers to help avoid damage to the wire sockets.

(✓) Reinstall the circuit board and back cover in the case.

(✓) Again plug the AC Monitor into the AC outlet. This time only the FAULT LED should light. NOTE: If the SPIKE LED lights, it should stay off when you press the RESET button.

(✓) Unplug the AC Monitor and remove the circuit board from the case.

NOTE: You may find it necessary to temporarily bend capacitor C1 up out of the way to perform the next step. Be sure to bend the capacitor back down into its proper position after you perform the step. Make sure the capacitor leads do not touch any other component. Also make sure the capacitor body is not touching jumper wire J1.

(✓) Reinstall the remaining jumper wire, removed earlier, in the wire sockets at J1. Use long-nose pliers to help avoid damage to the wire sockets.

(✓) Reinstall the circuit board and back cover in the case.

( ) Again plug the AC Monitor into the AC outlet. This time the FAULT LED and one or more of the LINE VOLTAGE LEDs should light. The number of LEDs lit depends upon the actual AC line voltage, but should generally include the six LEDs from 95 to 120 unless you know the line voltage is lower.

( ) Press the RESET button. The FAULT LED should go out.

( ) Unplug the AC Monitor.

(✓) Carefully peel away the backing paper from the Model label. Then refer to Pictorial 2-4 and press the label onto the back cover in the area shown.

(✓) Carefully peel away the backing paper from the blue and white label. Then press the label onto the front of this Manual. Be sure to refer to the numbers on this label in any communications you may have with the Heath Company about your kit.

OPERATION

WARNING: To prevent the possibility of electrical or fire hazard, do not expose the AC Monitor to rain or moisture.

Refer to Pictorial 3-1 while you read the following information, which describes the operation of your AC Monitor.

LINE VOLTAGE LEDs — These LEDs indicate the AC line voltage between 95 and 130-volts AC, in 5-volt steps. Each LED lights when the line voltage is just at its corresponding voltage, and then lights more brightly as the voltage increases to the next LED step. If an LED is dimly lit, you can estimate that the voltage is at or slightly above that step level. A brightly lit LED indicates that the voltage is above the center of the range and close to the next 5-volt step.

FAULT LED — This indicator lights whenever the AC voltage drops below 90 volts, even if it only occurs briefly. If the line voltage is completely lost for a particular period of time, the LED will light when the voltage returns.

SPIKE LED — This indicator lights whenever a single or a reoccurring transient spike has occurred as a temporary high voltage that is superimposed on the normal AC voltage. Such transients are generally caused when electrical machinery or lighting (on the same circuit as the Monitor) is turned on or off. Once the Spike LED lights, it will remain lit until you push the RESET button, or the Monitor loses the line voltage. If the Monitor should lose line voltage after a spike has occurred, the LED will not light when the line voltage returns.

RESET Button — This button turns off the Fault and Spike LEDs and resets their detection circuitry.

AC LINE VOLTAGE WAVEFORM

For the AC Monitor to be accurate and the fault and spike detection circuitry to operate correctly, the AC line voltage must be sinusoidal at a frequency of 60 Hz. The Monitor will not operate if it is connected to a DC power source. In addition, a nonsinusoidal (squarewave) source will result in display error or incorrect LED indications.

USING THE MONITOR

To use the AC Monitor, perform the following steps:

1. Plug the Monitor into a 120-volt (nominal) AC wall outlet. If the outlet has two sockets, use the lower socket so you can still use the upper socket for something else.

2. Push the RESET button to turn off the Fault LED and reset its circuit.

3. Look at the Line Voltage LEDs to determine the line voltage.

4. If the Fault LED should light, a temporary loss (or low value) of line voltage has occurred. If the Spike LED lights, an electrical transient has occurred. Either of these conditions could disturb the operation of any equipment that is connected to the same circuit as the Monitor. Push the RESET button to turn off the Fault or Spike LEDs.

IN CASE OF DIFFICULTY

WARNING: Dangerous voltages are present in the AC Monitor circuitry when it is connected to an AC outlet. Under no circumstances should you operate the AC Monitor with the case and/or back cover removed. Do not plug the Monitor into an AC outlet until a step specifically directs you to do so.

This section of the Manual is divided into three parts. Use the first part, "General Troubleshooting Information," to search for any trouble that may occur right after you assemble the kit.

The second part, "Troubleshooting Precautions," describes some care you should use when you troubleshoot and repair the AC Monitor. These suggestions are provided to help prevent you from damaging components during servicing.

The third part contains a "Troubleshooting Chart" that lists some specific problems and possible causes.

NOTE: It is important that you read the "General Troubleshooting Information" and "Troubleshooting Precautions" sections before you attempt to troubleshoot your AC Monitor.

General Troubleshooting Information

1. Recheck the circuit board assembly and wiring. It is frequently helpful to have a friend check you work. Someone who is not familiar with the unit may notice something that you have consistently overlooked.
2. About 90% of the kits that are returned to the Heath Company for repair do not function properly due to poor connections and soldering. Therefore, you can eliminate many troubles by reheating all of your connections to make sure they are soldered as described on Page 5 of this Manual.
3. Closely examine each circuit board foil to make sure that no solder bridges exist between foils. If you think you have a solder bridge but are not sure, you can check the foil pattern against the one shown in the "Circuit Board X-Ray View" on Page 33. To remove a solder bridge, hold a clean soldering iron tip between the two points that are bridged until the excess solder flows **down** onto the hot tip of the soldering iron. You can also use the desoldering braid supplied with the kit to remove solder bridges. Refer to the instructions on the package. Also examine the component side of the circuit board for solder that may have built up on the top side.

4. Check to make sure all transistors and integrated circuit U1 are in their proper locations. Make sure each lead is connected to the proper point and has been properly soldered to the foil.

5. Check the integrated circuits (ICs) for the proper installation. Make sure the pin 1 end of each IC is toward the index mark on the circuit board. Make sure each pin is in its socket and not bent out or under the IC. If you are not sure about the installation of an IC, use the IC lifter supplied with the kit to remove it so you can check for bent pins.

6. Check each capacitor value. Make sure the correct value capacitor is installed at each capacitor location. Also check electrolytic capacitors to make sure the positive (+) or negative (−) marked lead is in its corresponding circuit board hole.

7. Check each resistor value carefully to be sure that you wired the correct part into the circuit, as shown in the Pictorial. Pay particular attention to the resistors that have five bands, since each band is quite narrow. Use a magnifier to closely examine the color bands on these resistors. A resistor that is discolored, cracked, or shows any signs of bulging indicates that it is damaged and should be replaced. Since damaged resistors are often the result of some other difficulty (such as incorrect wiring), you should try to determine the cause as well as the effect of the difficulty.

8. Make sure the banded end of each diode is positioned correctly. NOTE: The banded end of all vertically-mounted diodes should be positioned away from the circuit board. If possible, use a magnifier to check for the correct part or type number at each diode location.

9. Check for bits of solder, wire ends, or other foreign matter which may be lodged in the wiring.

10. Be sure all component leads are cut off close to the foil on the circuit board so the leads do not touch together or other foils.

NOTE: In an extreme case where you are unable to resolve a difficulty, refer to the "Customer Service" information inside the rear cover of this Manual. Your Warranty is located inside the front cover.

COMPONENT REPLACEMENT

To remove faulty resistors, capacitors, or diodes, first clip them from their leads on the component side of the circuit board. Then heat the solder on the foil side and allow each lead to fall out of its hole. Preshape the leads of the replacement part and insert them into the circuit board holes. Solder the leads to the foil and cut off any excess lead lengths.

You can use the same procedure to remove transistors as you do other components. Make sure you install the replacement transistor with its leads in the proper holes. Then solder the leads quickly to avoid heat damage. Cut off any excess lead lengths.

FOIL REPAIR

To repair a break in a circuit board foil, first clear the solder resist coating to expose clean foil. Then bridge solder across the break. Use a length of bare wire to bridge large gaps in the foil. Lay the wire across the gap and solder each end to the foil. Carefully trim off any excess bare wire.

Troubleshooting Precautions

WARNING: Due to the presence of dangerous voltages and the direct connection of the circuitry to the line voltage outlet, severe injury or damage can occur if test equipment is connected for measurement of voltages or waveforms. Voltage measurements may only be made by fully qualified service personnel, or an authorized service facility.

CAUTION: Be especially careful when you remove or install any CMOS integrated circuits. To avoid any confusion, treat all ICs as if they were of this type. Refer to Detail 1-6A (Illustration Booklet, Page 6) for special handling procedures.

1. When you make repairs to the AC Monitor, be sure you eliminate the cause as well as the effect of the trouble. If, for example, you should find a damaged resistor, be sure you find out what damaged the resistor. If the cause is not eliminated, the replacement resistor may also become damaged when you put the Monitor back into operation.

2. In several areas of the circuit board, the foil patterns are quite narrow. When you unsolder a part to check or replace it, avoid excessive heat while you remove the part. A suction-type desoldering tool makes part removal easier. The desoldering braid supplied with the kit may also help you remove a part. Refer to the directions on the package for its use.

3. When you make ohmmeter tests, use only the R × 10, R × 100, or R × 1000 ranges. Higher or lower ranges may impose excessive current or voltage on the AC Monitor circuitry.

4. In any area where circuit operation appears to be improper, but is not clearly so, you may find it helpful to review the "Circuit Description."

5. Refer to the "Circuit Board X-Ray View" and the Schematic to locate the various components or circuit areas listed in the "Possible Cause" column of the "Troubleshooting Chart."

6. Refer to the "Semiconductor Identification" on Page 32 for identification of diode, transistor, and IC basings. A cross-reference of Heath part numbers to manufacturer's type numbers is also included.

Troubleshooting Chart

The following chart lists the "Condition" and "Possible Causes" of a number of malfunctions. If a particular part or area is mentioned (U1, SW1, etc.) as a possible cause, check that part to see if it is correctly installed. Also check the parts connected to it for poor connections. It is also possible, on rare occasions, for a part to be faulty and require replacement.

CONDITION	POSSIBLE CAUSE
The Monitor is completely inoperative; none of the LEDs light.	1. No voltage is present at the AC outlet. 2. Short circuit in the +V circuitry. 3. Open in the C1, R1, R2 circuitry. 4. Diodes D1 through D3. 5. Integrated circuit U1. 6. Resistors R1 through R4. 7. Capacitors C1 through C3, or C7. 8. LEDs V1 through V9, and V11.
The Fault LED does not light when you connect a shorting jumper between the collector and the emitter of transistor Q3.	

Troubleshooting Chart (Cont'd.)

CONDITION	POSSIBLE CAUSE
No Line Voltage LEDs light.	1. Jumper at J1 or S3/S5 is not installed. 2. Resistors R5 through R8 or R13 through R16. 3. Integrated circuit U2. 4. Diode D4 or D5. 5. Capacitor C4 or C5. 6. LEDs V3 through V9, and V11. 7. Low or nonsinusoidal line voltage.
Some Line Voltage LEDs light when you remove jumper J1.	
Only a few Line Voltage LEDs light when you install jumper J1.	
Inaccurate Line Voltage LED lighting (as compared to an accurate AC voltmeter).	
The Fault LED does not light when you first plug the AC Monitor in.	1. LED V2. 2. Integrated circuit U3. 3. Transistor Q3. 4. Diode D12 or D13. 5. Resistor R23, R24, or R28. 6. Capacitor C9. 7. Switch SW1.
The Fault LED does not turn off when you press the Reset button.	
The Fault LED does not stay off when you press and release the Reset button.	1. Integrated circuit U1 or U3. 2. Diode D11 or D12. 3. Resistors R25 through R29. 4. Capacitor C8 or C9. 5. Switch SW1.
The Fault LED lights frequently.	1. Significant or erratic line voltage variations. 2. Integrated circuit U1. 3. Capacitor C8. 4. Resistor R26. 5. Diode D11.
The Spike LED does not turn off when you press and hold the Reset button.	1. LED V1. 2. Transistor Q2. 3. Integrated circuit U3. 4. Resistor R17, R21, or R22.
The Spike LED does not light when you connect a shorting jumper between the collector and emitter of transistor Q2.	
The Spike LED does not light when you remove the jumper at J2.	1. Resistors R9 through R12, or R17 through R19. 2. Diode D6 through D9. 3. Transistor Q1. 4. Open connection at J2.
The Spike LED does not turn off when you install a jumper at J2.	
The Spike LED lights frequently.	1. Significant line voltage transients are present. 2. Resistors R9 through R12. 3. Diode D7 or D9. 4. Transistor Q1.

SPECIFICATIONS

NOTE: Accuracy specifications apply at 72°F (22°C) after a 10-minute warm up.

Voltage Display	One to eight LEDs light in a string to indicate the AC line voltage from 95 to 130-volts AC, in 5-volt AC steps.
Accuracy	± 5-volts AC at each threshold (± 3 volts AC, if calibrated with an ohmmeter).
Fault Indication	A separate LED lights whenever the AC voltage falls below 90 volts AC for at least 1 cycle (0.016 second). The LED remains lit until the Reset button is pushed.
Spike Indication	A separate LED lights if a voltage transient occurs. Typical sensitivity is 250 volts for repetitive spikes and 300 volts for intermittent spikes. The LED remains lit until the Reset button is pushed.
AC Voltage Input	80 to 135 volts AC, 60 Hz, 2.5 watts.
Dimensions	3-5/8″ H × 2-3/8″ W × 1-1/4″ D (9.2 × 6.0 × 3.2 cm).
Weight	3-1/2 oz. (100 g).

◆

The Heath Company reserves the right to discontinue products and to change specifications at any time without incurring any obligation to incorporate new features in products previously sold.

CIRCUIT DESCRIPTION

Refer to the Block Diagram and the Schematic while you read this "Circuit Description." The circuit is first described from a general standpoint, and is then described in more detail.

The AC Monitor indicates AC line voltage present at an AC outlet. In addition, a Fault LED (light-emitting diode) lights to indicate whenever the line voltage falls below a particular value, or has been completely interrupted. A separate LED lights to indicate the presence of line-voltage transient disturbances that are greater than 200 volts. Once either of these LEDs has been activated, they remain lit until you push the Reset button.

AC voltage applied to the circuit passes through capacitor C1 to the +V supply circuit, which provides DC voltage to power the measurement and LED circuits. The AC voltage is also applied to two divider circuits for voltage sensing and spike sensing.

A portion of the AC voltage is tapped off the voltage-sensing divider and applied to the input (IN) of integrated circuit U2. This IC contains a series of comparator circuits which respond to the voltage at the input with respect to the differential voltage between the $R_{REF\ HI}$ and $R_{REF\ LO}$ inputs. The threshold voltage sets the lower point of the comparator range and the span voltage sets the upper point. Whenever the positive peak of the divided AC voltage falls within the span range, the outputs of U2 light one or more of the Line Voltage LEDs. The value of the threshold voltage is scaled so that it is equivalent to an 85 volt AC source voltage, and the span voltage is scaled so it is equivalent to a 50 volt AC difference. The ten outputs of U2, therefore, correspond to 5 volt increments from 85 volts to 135 volts AC. Nine of U2's outputs directly drive the Line voltage LEDs, with the 135 volt AC (and above) output connected to the 130 volt output. The current passing through resistor R16 from the R_{OUT} output of U2 programs the current that passes through the LEDs.

The 90 volt AC output from U2 is applied to a circuit that detects low line voltage. Each time the line voltage peak exceeds a 90-volt AC level, this output goes low, and discharges a capacitor. But if the line voltage drops below 90 volts AC, for at least one cycle, the capacitor is not discharged. The increasing charge voltage of the capacitor quickly drives a comparator/latch circuit to a switching point. When this occurs, the circuit is set and cannot be changed unless you press the Reset button. The output of this circuit lights the Fault LED. If the line voltage is completely interrupted, a power-on circuit automatically causes the latch circuit to light the Fault LED as soon as the line voltage returns.

A portion of the AC voltage is tapped off the spike-sensing divider and drives transistor Q1 through either the "+" or "−" peak-detection zener diodes. The conduction voltage of these diodes together with the spike-sensing divider makes this circuit respond only to higher than normal (transient) voltages. If either of these diode circuits is biased beyond its conduction voltage, Q1 pulses a latch circuit. This sets the latch and lights the Spike LED. The LED will remain lit until you press the Reset button.

The circuitry will now be explained in detail.

+V SUPPLY

During the positive half cycle of the AC line voltage, current flows through C1, R1/R2, and D3 to charge capacitor C2. The combined zener conduction voltage of diodes D1 and D2 limit the charge voltage on C2. During the negative half cycle, current flows only through C1, R1/R2, D1 and D2 to ground. D1 and D2 now have only a small forward-biased voltage drop. Capacitor C1 therefore discharges so that C2 can be charged on the next positive half cycle. Resistors R1 and R2 provide transient current protection and have very little effect on normal operation. The DC voltage on C2 is applied to the input of U1.

Integrated circuit U1 is a three-terminal adjustable regulator that maintains a constant voltage across R3 by conducting current from C2. Since there is no appreciable current through the adjust (ADJ) terminal of U1, the current through R4 is also constant. If the load current at the output of U1 should increase, the output voltage will tend to slightly decrease. Since this decreases the voltage across R3 and R4, U1 conducts more current from C2 to support the increased load. Capacitors C3 and C7 provide transient and noise filtering of the +V supply voltage. U1 contains internal current-limiting circuitry to provide protection against a short circuit at its output.

THRESHOLD & SPAN VOLTAGES

Current flow from the +V supply passes through R13 and biases D4 and D5 to their conduction voltages, which are accurately known. Values in the voltage-sensing divider are scaled so that the voltage across D5 is equivalent to an AC line voltage of 85 volts. This voltage is applied to the $R_{REF\ LO}$ input of U2. Since the voltage across D5 represents 85 volts AC, the voltage across D4 also represents a voltage difference of 85 volts AC. Resistors R14 and R15 divide this difference voltage so it is equivalent to 50 volts above 85 volts (135 volts). Since the internal circuitry of U2 presents a resistive load across R15, a compensation resistor (RCAL) is required across R14 to maintain the correct R14, R15 voltage division. Different values for RCAL are provided because U2's internal resistance may vary. By measuring this internal resistance, you can determine what value resistor must be installed (the jumper between S5 and S3 must be removed to make this measurement). If an ohmmeter is not available, a "default" value is installed to minimize the worst-case error.

VOLTAGE SENSING DIVIDER

Resistors R5 through R8 form a precision voltage divider that reduces the AC line voltage to the input (IN) of U2. Jumper J1 is provided so you can remove the input voltage to simulate a low line voltage and check the fault circuit.

INTEGRATED CIRCUIT U2

Integrated circuit U2 contains several circuits that effectively measure the voltage at the input and energize the Line Voltage LEDs. The major circuits are a resistive divider of ten resistors, ten comparators, and ten drivers.

The resistive divider is formed by ten resistors that are connected between the $R_{REF\ HI}$ pin and the $R_{REF\ LO}$ pin. Each of the taps from this divider are applied to one input of a comparator, which in turn feed one of the driver circuits.

Each of the comparators continuously compare the sine wave AC voltage at the input (IN) pin to the resistive divider voltage. At any of the ten comparators, whenever the the voltage at the input (IN) pin is greater than the voltage coming from its tap of the resistive divider, the comparator's output goes low.

The output of each comparator is connected to a driver circuit that lights one or more of the Line Voltage LEDs. The open circuit at the Mode input (pin 9) of U2 selects a "dot" operation in which only one drive output is low at a time, depending upon the highest comparator that has a low output.

Below 90 volts AC, all comparator and driver circuit outputs are high so that none of the LEDs are lit. When the AC voltage rises above 90 volts, the output of the first (lowest) driver circuit (Q1) goes low at the sine wave peak. This drives the fault detection circuitry described later.

Once the Q1 threshold is exceeded by a high voltage, the next threshold where the Q2 output ("95") goes low is reached. As this output goes low, the Q1 output returns high. A low at the Q2 output causes current flow through LED V3. As the sine wave voltage further increases, the threshold where the Q3 output goes low is reached. The Q3 output then goes low and the Q2 output returns high. The low at the Q3 output causes current flow through LEDs V3 **and** V4. For higher points on the sine wave, the low output continues to shift in U2 until no additional thresholds are exceeded. This causes the number of lighted LEDs for each AC cycle to correspond to the voltage peak. Since the sine wave repeats as long as AC is applied, the repetition of on each cycle gives the appearance of a continuous string of LEDs. For voltages up to the 130-volt AC level (the output of Q9 is low at the peak), another LED is included for each 5 volt AC increase until the entire V3 to V11 string is lit. At 135 volts AC and above, the highest comparator is on and the Q10 output again lights the entire string. Further voltage increases causes no change.

On the decreasing side of the sine wave, the low/high, on/off sequence is reversed. The negative portion of the AC sine wave has no effect and is limited within U2 by an internal resistor/diode circuit.

FAULT DETECTION

Diodes D11 and D12, NAND gates U3C and U3D, transistor Q3, and LED V2 are the major parts of the fault circuit. This circuit lights the LED whenever the AC line voltage drops below 85 volts, or if the line voltage has been off for some time.

When you first plug the Monitor in, you can assume that capacitor C9 is completely discharged. The logic low caused by this discharged state is applied to U3C pin 8 and forces the output at pin 10 to be at a logic high. This logic high is also applied through diode D12 to one input (pin 12) of U3D to keep the input high, regardless of any voltage on capacitor C8. Resistor R27 isolates the voltage on C8 from having any effect on pin 12 while D12 is holding pin 12 high. As long as the Reset button is not being depressed, U3D pin 13 is pulled high by resistor R29 and these combined high levels at pins 12 and 13 force the output (pin 11 and U3C input pin 9) to be low. This low reinforces the low present at pin 8.

As capacitor C9 charges through resistor R28, a high is applied to pin 8 but does not have any effect upon the output of U3C because pin 9 is still low. This effectively latches the circuit into this condition. The high at pin 10 turns transistor Q3 on, which lights Fault LED V2. Resistor R24 provides current limiting for the LED. Diode D13 quickly discharges capacitor C9 through the +V load circuitry if the AC line voltage is interrupted.

Resistor R25 holds the Q1 output (pin 1) of U2 at +V whenever the output is high. As long as the Q1 output goes low at least once per AC cycle, diode D11 discharges capacitor C8. This prevents the capacitor voltage from reaching the logic high threshold of U3D pin 12. When you press the Reset button, a low is applied to U3D pin 13, which causes highs at pins 11 and 9. This high at pin 9 combined with a high at pin 8 forces a low at pin 10. When pin 10 is low, diode D12 is reverse biased and can no longer override the voltage at pin 12 (from C8). As long as the voltage at capacitor C8 is low, it reinforces the reset condition if pin 13 goes high. When you release the Reset button, the circuit does not change logic states.

If the AC line voltage should even briefly fall below 90 volts, the Q1 output of U2 will not go low during one or more AC cycles. This causes capacitor C8 to charge through resistor R26 and causes U3D pin 12 to go above a logic high level. Resistor R27 has no effect on pin 12, at this time, due to the very high input resistance of U3. The high at pin 12 combined with the high at pin 13 causes the circuit to again latch into the fault state and will light LED V2 until you push the Reset button.

SPIKE DETECTION

Diodes D6 through D9, transistors Q1 and Q2, NAND gates U3A and U3B, and LED V1 are the major parts of the spike detection circuit. This circuit lights the LED whenever momentary high transient voltages occur on the AC line voltage. These voltages can disturb the operation of computers and other types of equipment.

Resistors R9, R11, and R12 form a voltage divider that drives the D6/D7 and D8/D9 circuits. When a positive high-voltage transient occurs, diode D6 is forward biased and causes diode D7 to conduct when its threshold voltage is exceeded. This generates a positive voltage across resistor R18. At the same time, diode D8 is reverse biased and there is no current flow to resistor R19. Since the gain of transistor Q1 is high, due to its high collector resistance, very little base current is required to cause Q1 to turn on and produce a logic low at its collector and at U3A pin 1.

When a negative high-voltage transient occurs, diode D8 becomes forward biased and causes diode D9 to conduct when its threshold voltage is exceeded. This generates a negative voltage across resistor R19. At the same time, diode D6 is reverse biased and there is no current flow to resistor R18. The negative emitter voltage at resistor R19 forward biases the base-to-emitter junction of Q1 and Q1's collector voltage is again forced low. The presence of either positive or negative transients, therefore, applies a low to U3A pin 1. If you remove jumper J2, such as during circuit testing, the full AC line voltage is directly applied to the diode circuits. The peak AC voltage now exceeds the conduction threshold voltage of diodes D7 and D8, which turns transistor Q1 on to simulate high-voltage transients.

NAND gates U3A and U3B form a latch circuit that functions the same as the latch in the fault-detection circuit, but has a slightly different configuration. When you push the Reset button, the low at U3B pin 6 forces a high at pins 4 and 2. If you assume that U3A pin 1 is high, pin 3 is forced low to reinforce the low at pin 6. The logic states of the circuit are maintained when you release the Reset button, as long pin 1 is high. If this input should even briefly go low, the high at pin 3 and pin 5 combined with the high at pin 6 forces pin 4 low to reinforce the low at pin 1. This logic state is now retained until you push the Reset button. A high at U3A pin 3 turns transistor Q2 on through resistor R21, which lights Spike LED V1 to indicate that a transient has occurred.

SEMICONDUCTOR IDENTIFICATION

DIODES

COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	KEY NUMBER
D1	56-32	13.5-volt zener	A1
D2	56-32	13.5-volt zener	A1
D3	57-27	1N5397	A1
D4	56-85	5-volt zener, 1%	A1
D5	56-85	5-volt zener, 1%	A1
D6	56-93	FD-333	A1
D7	56-48	110-volt zener	A1
D8	56-93	FD-333	A1
D9	56-48	110-volt zener	A1
D10	Not used		
D11	56-56	1N4149	A1
D12	56-56	1N4149	A1
D13	56-56	1N4149	A1

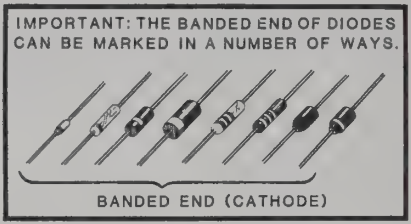
TRANSISTORS

COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	KEY NUMBER
Q1	417-875	2N3904	B1
Q2	417-875	2N3904	B1
Q3	417-875	2N3904	B1

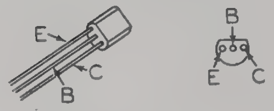
INTEGRATED CIRCUITS

COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	KEY NUMBER
U1	442-772	LM317L	C1
U2	442-798	LM3914N	C2
U3	443-603	CD4011AE	C3

A1


IMPORTANT: THE BANDED END OF DIODES CAN BE MARKED IN A NUMBER OF WAYS.
BANDED END (CATHODE)

B1



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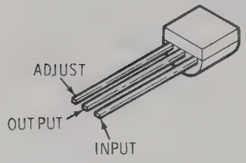

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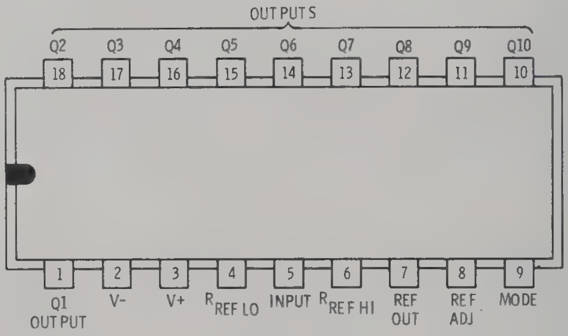

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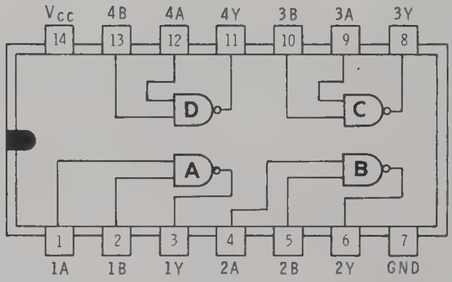


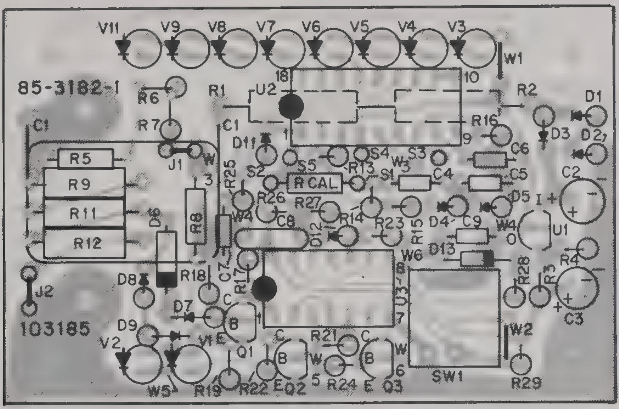
CIRCUIT BOARD X-RAY VIEW

NOTE: To find the PART NUMBER of a component for the purpose of ordering a replacement part:

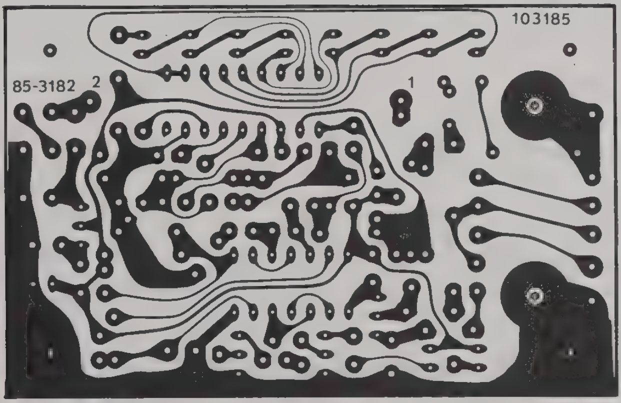
A. Find the circuit component number (R5, C3, etc.) on the X-Ray View.

B. Locate this same number in the "Circuit Component Number" column of the "Parts List."

C. Adjacent to the circuit component number, you will find the PART NUMBER and DESCRIPTION which you must supply when you order a replacement part.



(Shown from the component side.)



(Shown from the foil side.)

CUSTOMER SERVICE

REPLACEMENT PARTS

Please provide complete information when you request replacements from either the factory or Heath/Zenith Computers and Electronics centers. Be certain to include the **HEATH** part number exactly as it appears in the parts list.

ORDERING FROM THE FACTORY

Print all of the information requested on the parts order form furnished with this product and mail it to Heath. For telephone orders (parts only) dial 616 982-3571. If you are unable to locate an order form, write us a letter or card including:

- Heath part number.
- Model number.
- Date of purchase.
- Location purchased or invoice number.
- Nature of the defect.
- Your payment or authorization for COD shipment of parts not covered by warranty.

Mail letters to: Heath Company
Benton Harbor
MI 49022
Attn: Parts Replacement

Retain original parts until you receive replacements. Parts that should be returned to the factory will be listed on your packing slip.

OBTAINING REPLACEMENTS FROM HEATH/ZENITH COMPUTER AND ELECTRONICS CENTERS

For your convenience, "over the counter" replacement parts are available from the Heath/Zenith Computer and Electronics centers listed in your catalog. Be sure to bring in the original part and purchase invoice when you request a warranty replacement from a Heath/Zenith Computer and Electronics center.

TECHNICAL CONSULTATION

Need help with your kit? — Self-Service? — Construction? – Operation? — Call or write for assistance. You'll find our Technical Consultants eager to help with just about any technical problem except "customizing" for unique applications.

The effectiveness of our consultation service depends on the information you furnish. Be sure to tell us:

- The Model number and Series number from the blue and white label.
- The date of purchase.
- An exact description of the difficulty.
- Everything you have done in attempting to correct the problem.

Also include switch positions, connections to other units, operating procedures, voltage readings, and any other information you think might be helpful.

Please do not send parts for testing, unless this is specifically requested by our Consultants.

Hints: Telephone traffic is lightest at midweek — please be sure your Manual and notes are on hand when you call.

Heath/Zenith Computer and Electronics center facilities are also available for telephone or "walk-in" personal assistance.

REPAIR SERVICE

Service facilities are available, if they are needed, to repair your completed kit. (Kits that have been modified, soldered with paste flux or acid core solder, cannot be accepted for repair.)

If it is convenient, personally deliver your kit to a Heath/Zenith Computers and Electronics center. For warranty parts replacement, supply a copy of the invoice or sales slip.

If you prefer to ship your kit to the factory, attach a letter containing the following information directly to the unit:

- Your name and address.
- Date of purchase and invoice number.
- Copies of all correspondence relevant to the service of the kit.
- A brief description of the difficulty.
- Authorization to return your kit COD for the service and shipping charges. (This will reduce the possibility of delay.)

Check the equipment to see that all screws and parts are secured. (Do not include any wooden cabinets or color television picture tubes, as these are easily damaged in shipment. Do not include the kit Manual.) Place the equipment in a strong carton with at least THREE INCHES of *resilient* packing material (shredded paper, excelsior, etc.) on all sides. Use additional packing material where there are protrusions (control sticks, large knobs, etc.). If the unit weighs over 15 lbs., place this carton in another one with 3/4" of packing material between the two.

Seal the carton with reinforced gummed tape, tie it with a strong cord, and mark it "Fragile" on at least two sides. Remember, the carrier will not accept liability for shipping damage if the unit is insufficiently packed. Ship by prepaid express, United Parcel Service, or insured Parcel Post to:

Heath Company
Service Department
Benton Harbor, Michigan 49022

HEATH
ZENITH

HEATH COMPANY • BENTON HARBOR, MICHIGAN

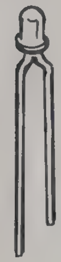
THE WORLD'S FINEST ELECTRONIC EQUIPMENT IN KIT FORM

LITHO IN U.S.A.

ON BOOKLET

Part of 595-3616

A6



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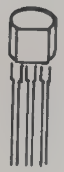

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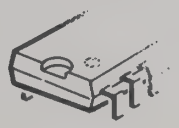
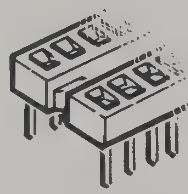


ALWAYS IDENTIFY AN IC BY THE PART NUMBER OR THE TYPE NUMBER
NOTE: THE STYLE MAY BE SLIGHTLY DIFFERENT THAN SHOWN.

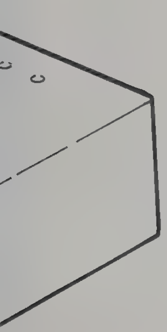
C2



ALWAYS IDENTIFY AN I.C SOCKET BY COUNTING ITS PINS.
NOTE: THE STYLE MAY BE SLIGHTLY DIFFERENT THAN SHOWN.

D1

HEATH COMPANY
Benton Harbor, Michigan 49022
MODEL SK-211
90-130 VAC, 3 WATTS MAX
EIA-416
CAUTION: TO PREVENT ELECTRICAL SHOCK HAZARD, DO NOT APPLY POWER WHILE COVER IS REMOVED.



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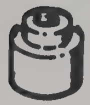

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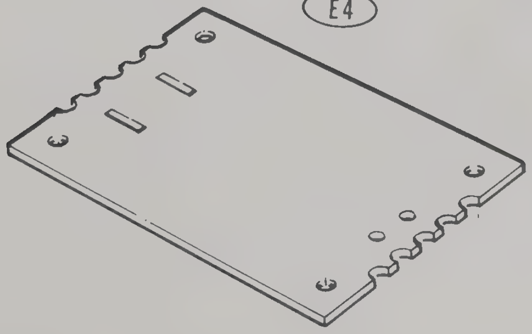

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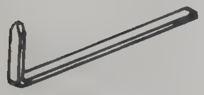

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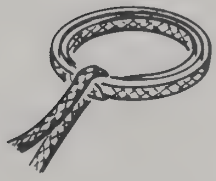

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HEATH COMPANY • BENTON HARBOR, MICHIGAN

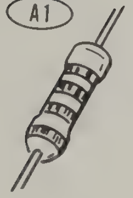
THE WORLD'S FINEST ELECTRONIC EQUIPMENT IN KIT FORM

LITHO IN U.S.A.

ILLUSTRATION BOOKLET

Part of 595-3616

A1



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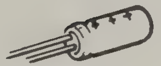

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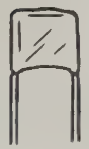

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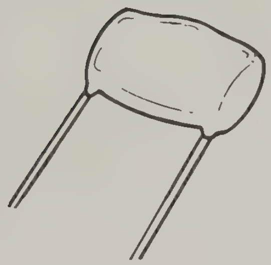

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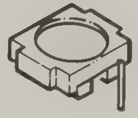

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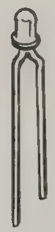

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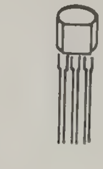

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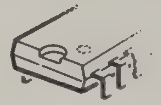
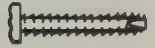


ALWAYS IDENTIFY AN IC BY THE PART NUMBER OR THE TYPE NUMBER
NOTE: THE STYLE MAY BE SLIGHTLY DIFFERENT THAN SHOWN.

B1



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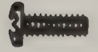

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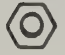

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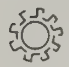

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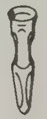

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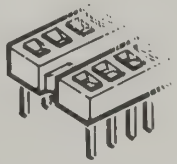

ALWAYS IDENTIFY AN I.C SOCKET BY COUNTING ITS PINS.
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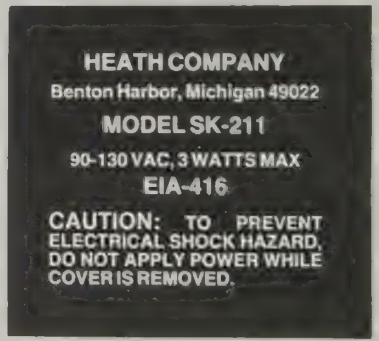
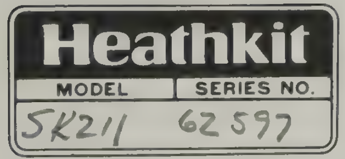
D1



HEATH COMPANY
Benton Harbor, Michigan 49022
MODEL SK-211
90-130 VAC, 3 WATTS MAX
EIA-416
CAUTION: TO PREVENT ELECTRICAL SHOCK HAZARD, DO NOT APPLY POWER WHILE COVER IS REMOVED.

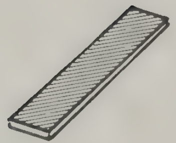
D2



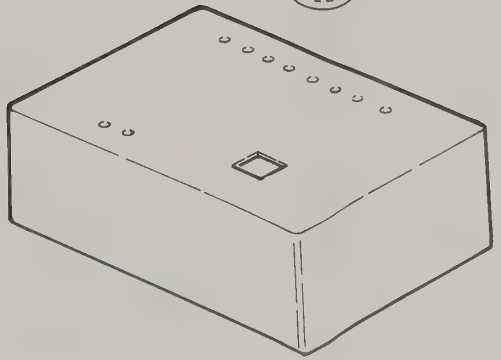
Heathkit

MODEL	SERIES NO.
SK211	62597

E1



E2



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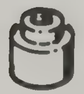

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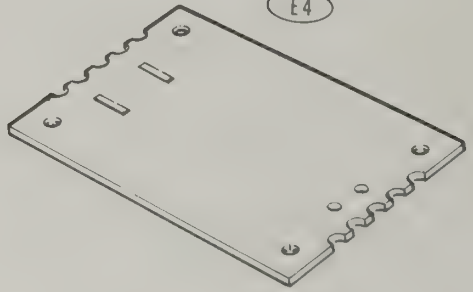

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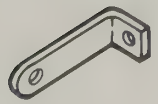

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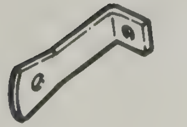

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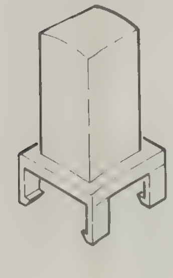
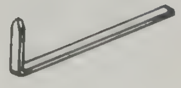


E8



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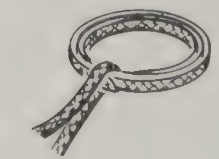

Model SK-211

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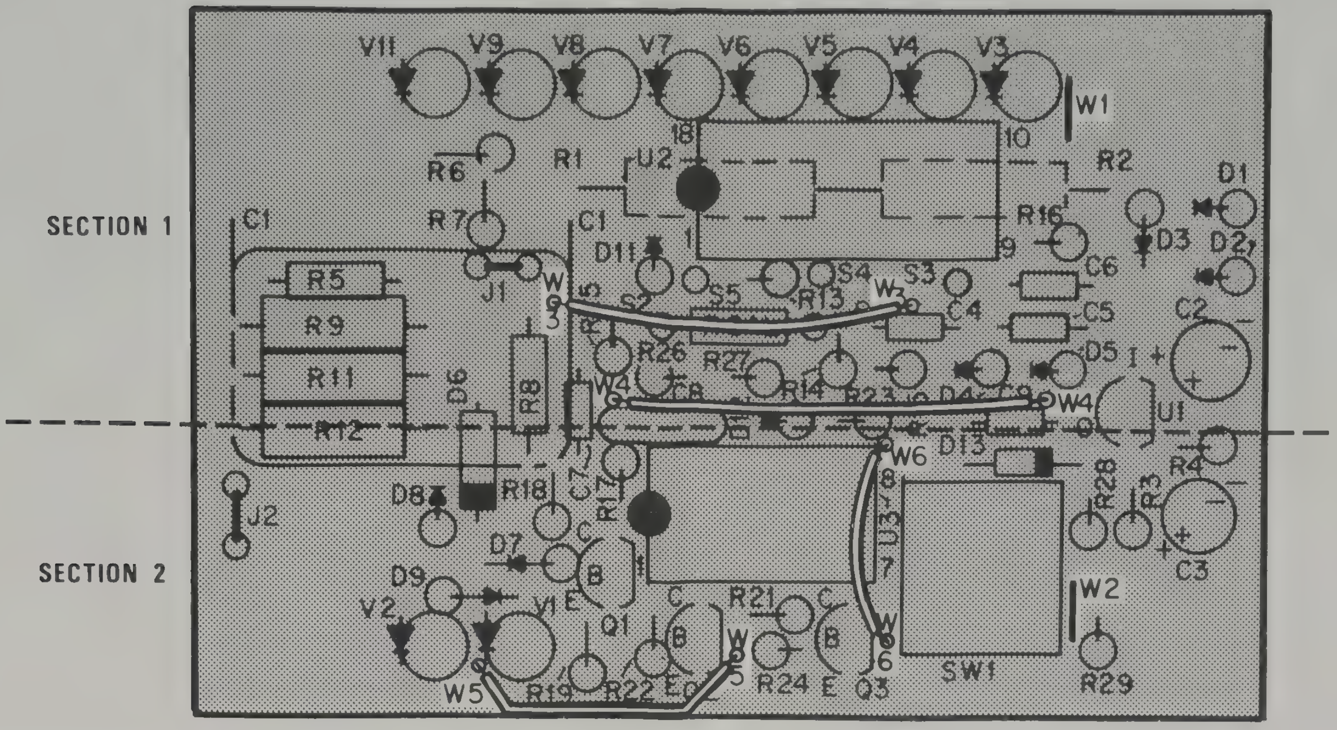
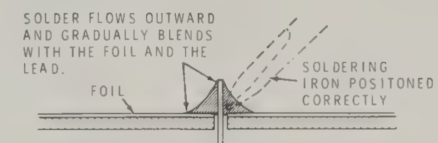


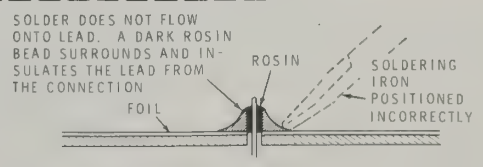
PICTORIAL 1-1

A GOOD SOLDER CONNECTION

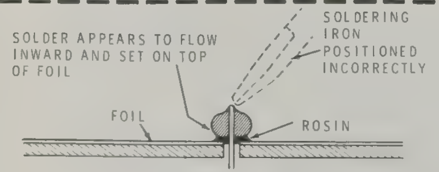

SOLDER FLOWS OUTWARD AND GRADUALLY BLENDS WITH THE FOIL AND THE LEAD.
FOIL
SOLDERING IRON POSITONED CORRECTLY

When you heat the lead and the circuit board foil at the same time, the solder will flow evenly onto the lead and the foil. The solder will make a good electrical connection between the lead and the foil.

POOR SOLDER CONNECTIONS


SOLDER DOES NOT FLOW ONTO LEAD. A DARK ROSIN BEAD SURROUNDS AND INSULATES THE LEAD FROM THE CONNECTION
ROSIN
FOIL
SOLDERING IRON POSITIONED INCORRECTLY

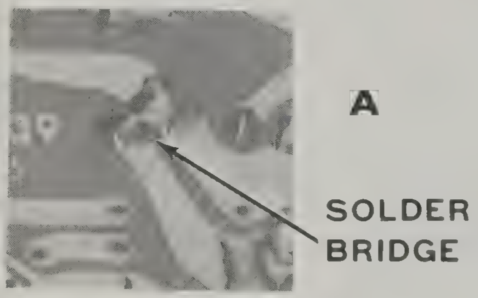
When the lead is not heated sufficiently, the solder will not flow onto the lead as shown above. To correct, reheat the connection and, if necessary, apply a small amount of additional solder to obtain a good connection.


SOLDERING IRON POSITIONED INCORRECTLY
SOLDER APPEARS TO FLOW INWARD AND SET ON TOP OF FOIL
FOIL
ROSIN

When the foil is not heated sufficiently the solder will blob on the circuit board as shown above. To correct, reheat the connection and, if necessary, apply a small amount of additional solder to obtain a good connection.

SOLDER BRIDGES

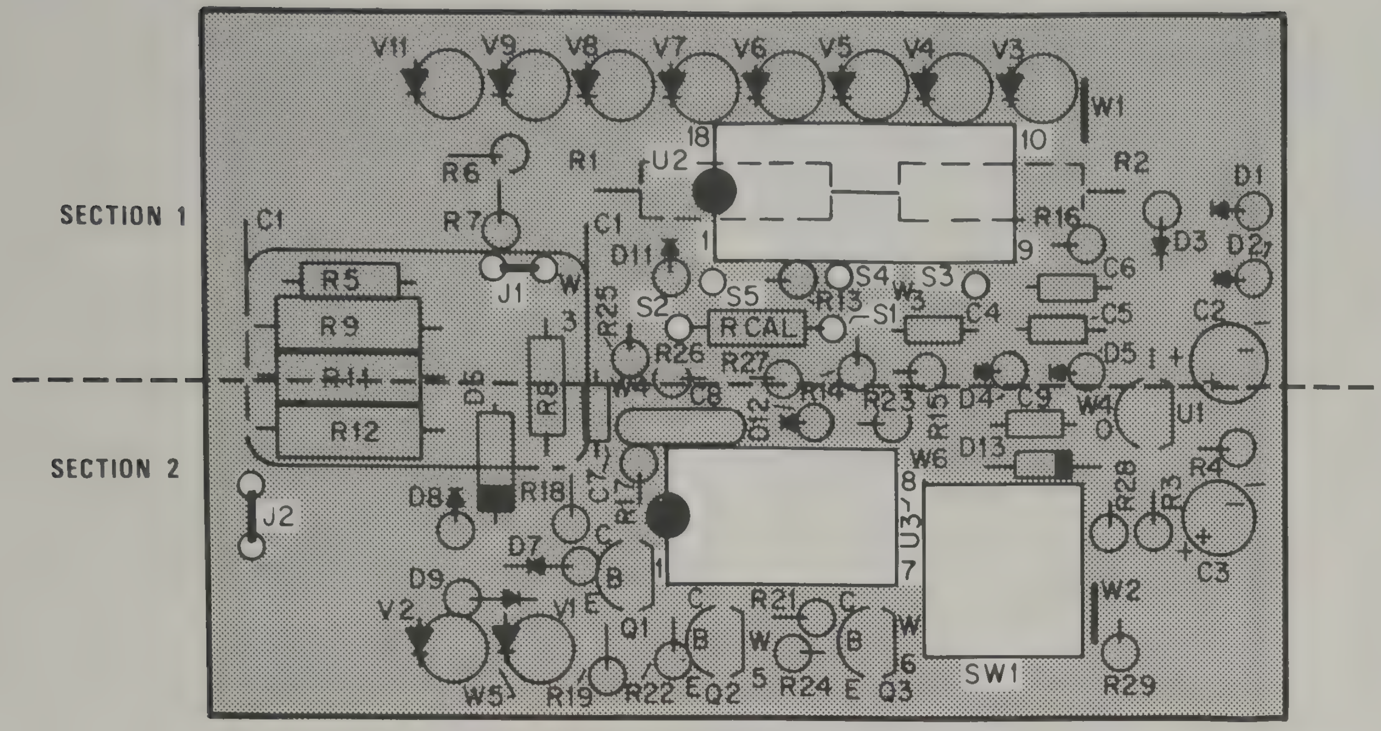
A solder bridge between two adjacent foils is shown in photograph **A**. Photograph **B** shows how the connection should appear. A solder bridge may occur if you accidentally touch an adjacent previously soldered connection, if you use too much solder, or if you "drag" the soldering iron across other foils as you remove it from the connection. A good rule to follow is: always take a good look at the foil area around each lead before you solder it. Then, when you solder the connection, make sure the solder remains in this area and does not bridge to another foil. This is especially important when the foils are small and close together. NOTE: It is alright for solder to bridge two connections on the same foil.


A

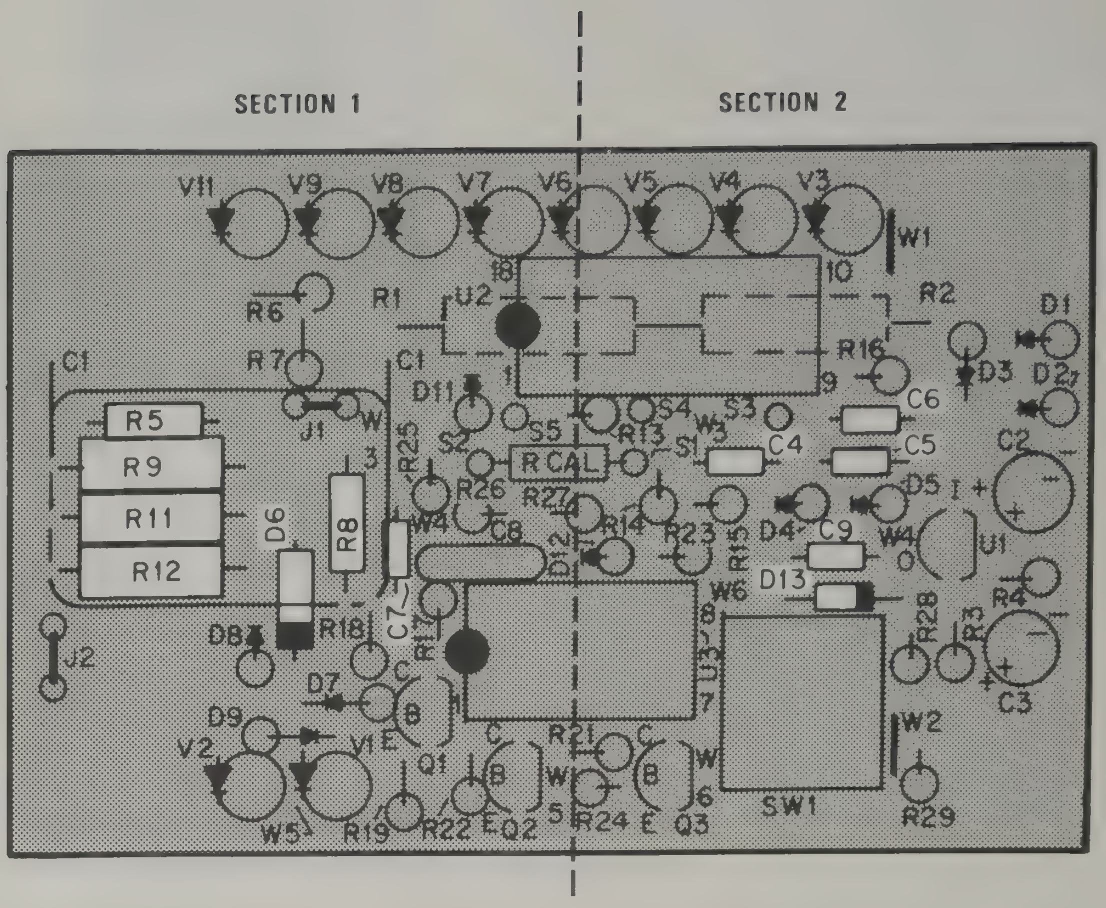
B

Use only enough solder to make a good connection, and lift the soldering iron straight up from the circuit board. If a solder bridge should develop, turn the circuit board foil-side-down and heat the solder between connections. The excess solder will run onto the tip of the soldering iron, and this will remove the solder bridge. NOTE: The foil side of most circuit boards has a coating on it called "solder resist." This is a protective insulation to help prevent solder bridges.

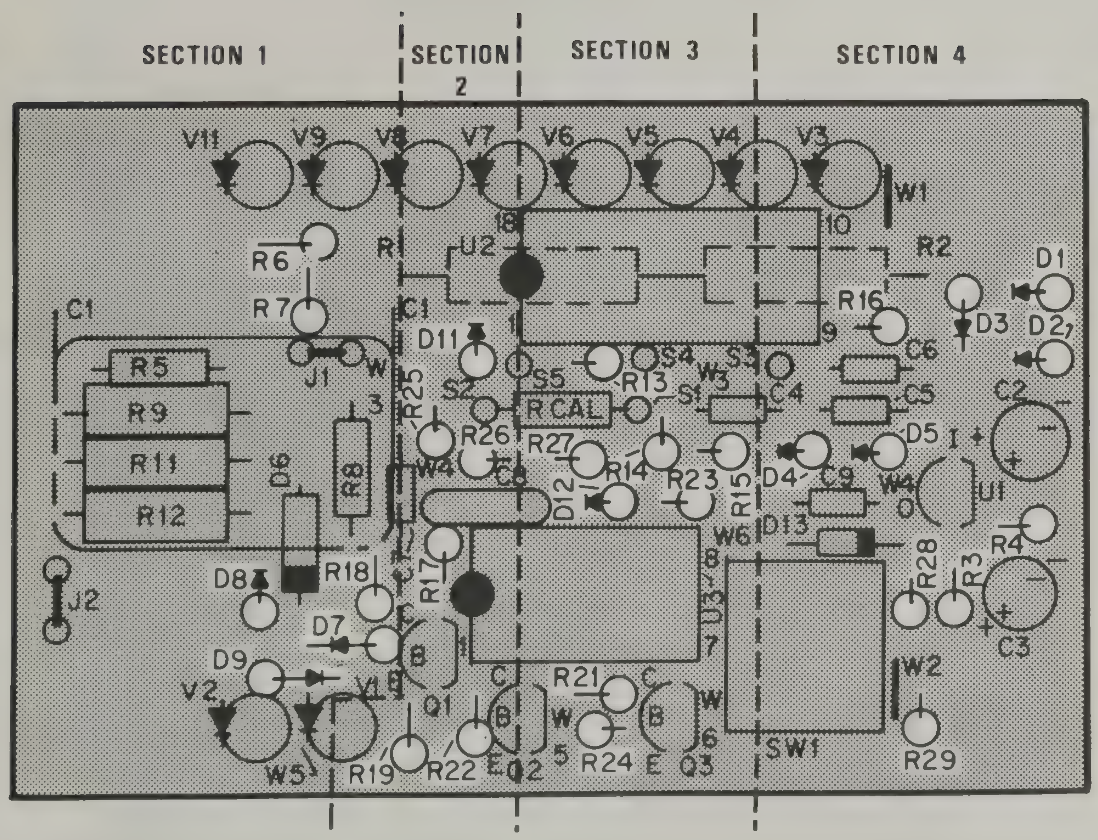
Detail 1-1A



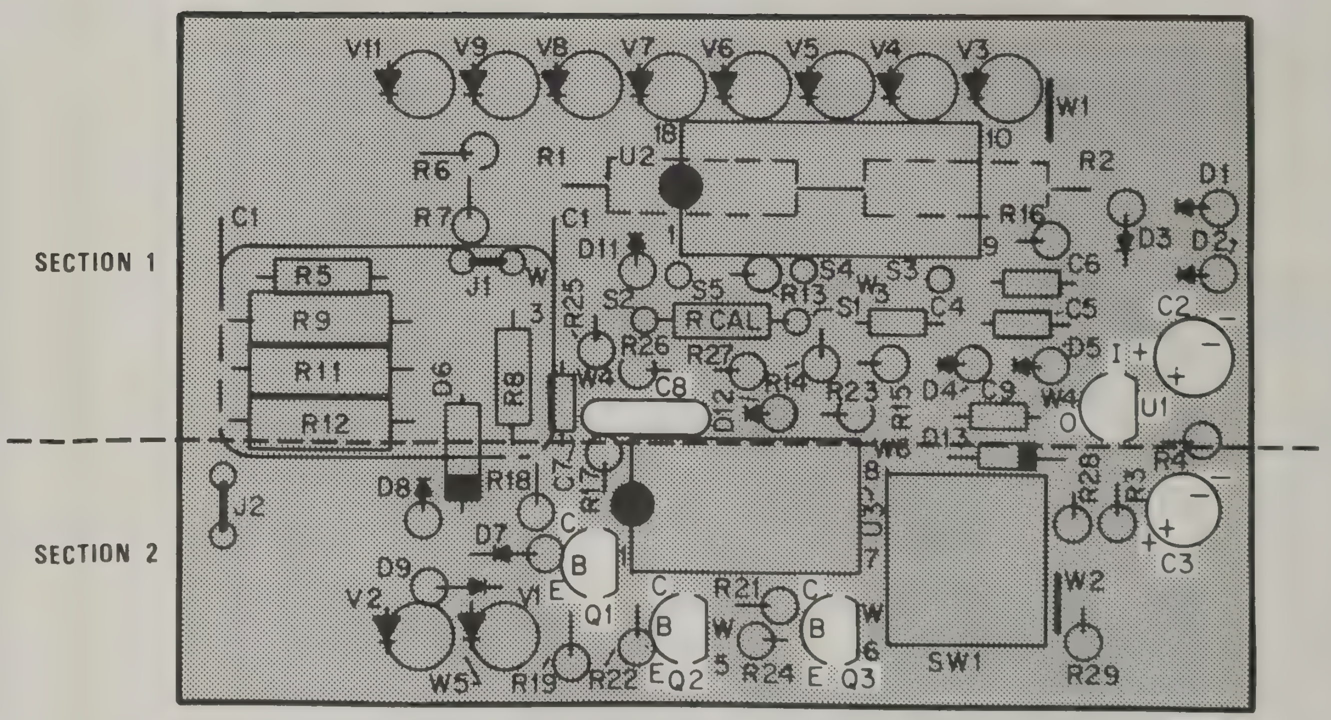
PICTORIAL 1-2



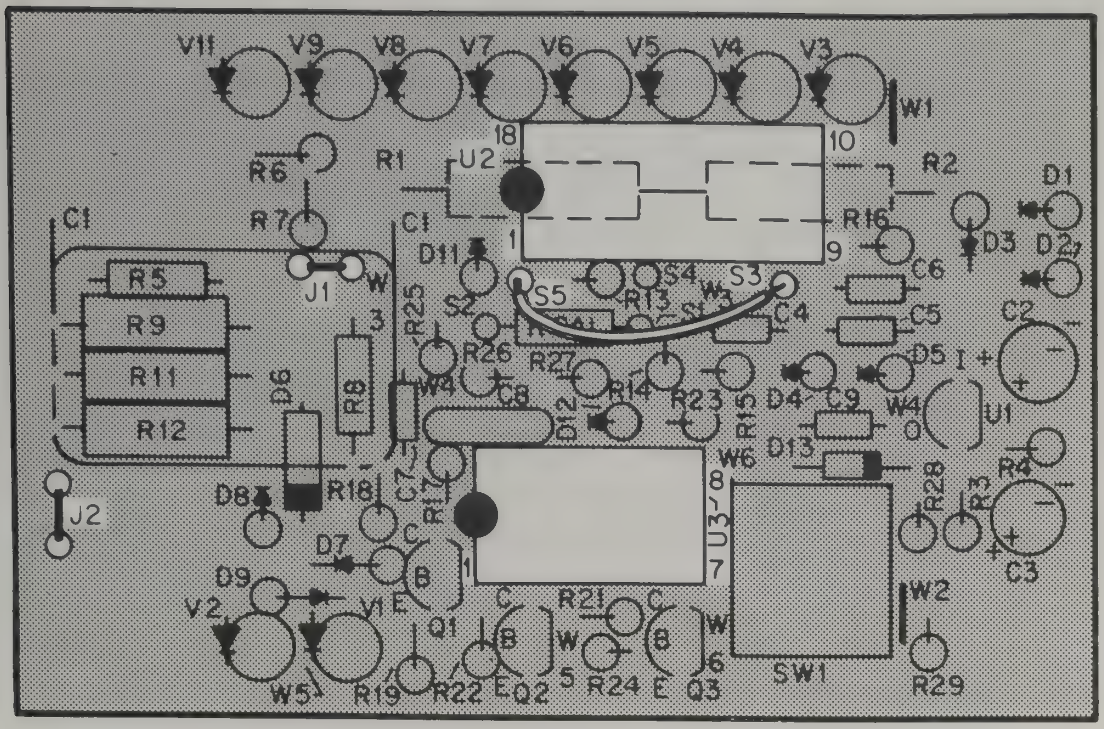
PICTORIAL 1-3



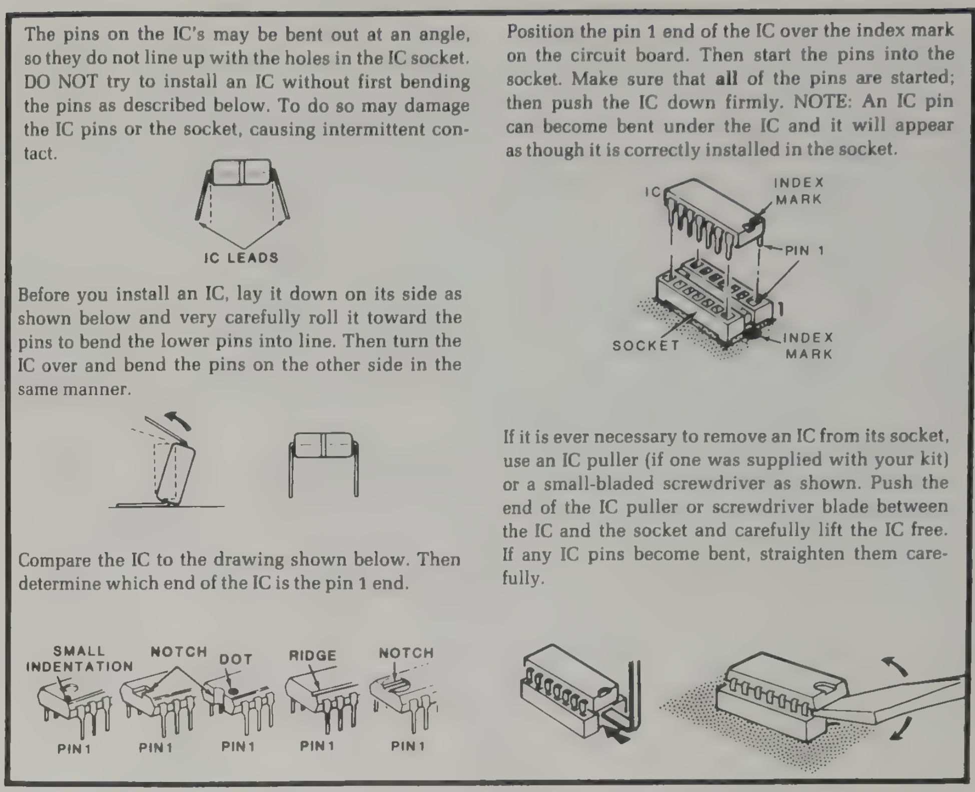
PICTORIAL 1-4



PICTORIAL 1-5



PICTORIAL 1-6


The pins on the IC's may be bent out at an angle, so they do not line up with the holes in the IC socket. DO NOT try to install an IC without first bending the pins as described below. To do so may damage the IC pins or the socket, causing intermittent contact.

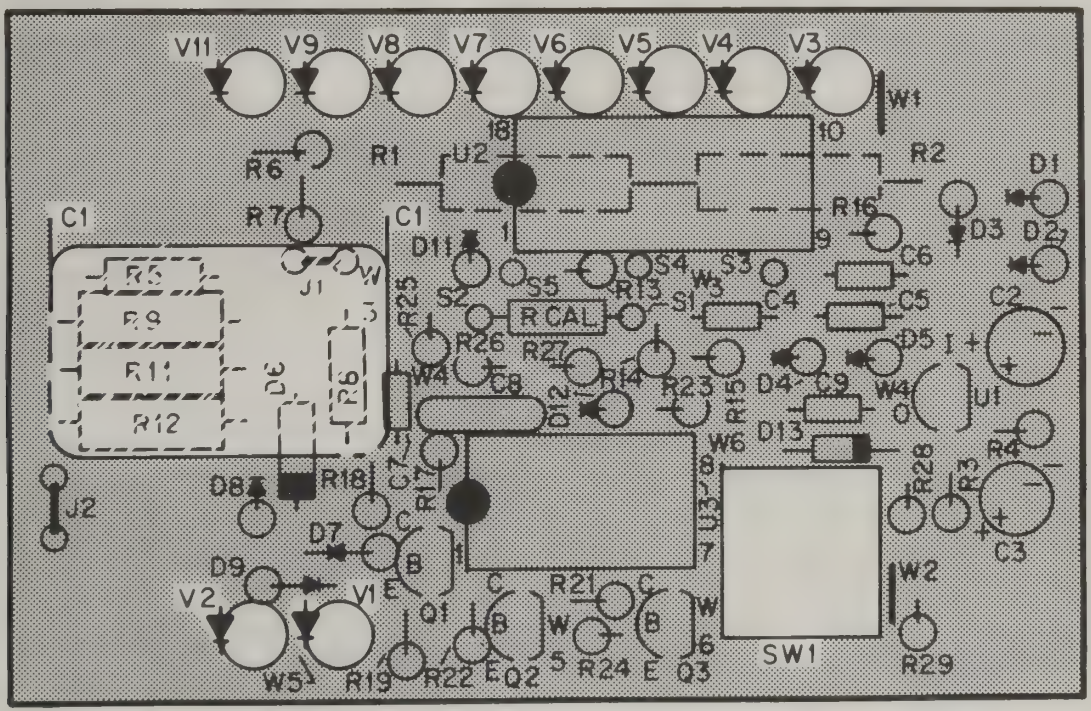
Before you install an IC, lay it down on its side as shown below and very carefully roll it toward the pins to bend the lower pins into line. Then turn the IC over and bend the pins on the other side in the same manner.

Compare the IC to the drawing shown below. Then determine which end of the IC is the pin 1 end.

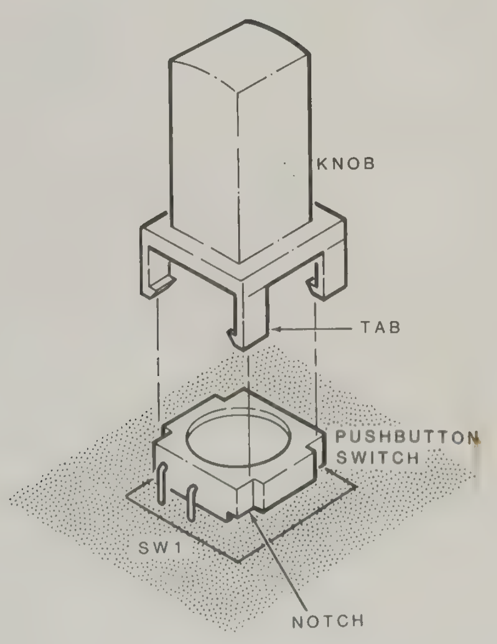
Position the pin 1 end of the IC over the index mark on the circuit board. Then start the pins into the socket. Make sure that **all** of the pins are started; then push the IC down firmly. NOTE: An IC pin can become bent under the IC and it will appear as though it is correctly installed in the socket.

If it is ever necessary to remove an IC from its socket, use an IC puller (if one was supplied with your kit) or a small-bladed screwdriver as shown. Push the end of the IC puller or screwdriver blade between the IC and the socket and carefully lift the IC free. If any IC pins become bent, straighten them carefully.

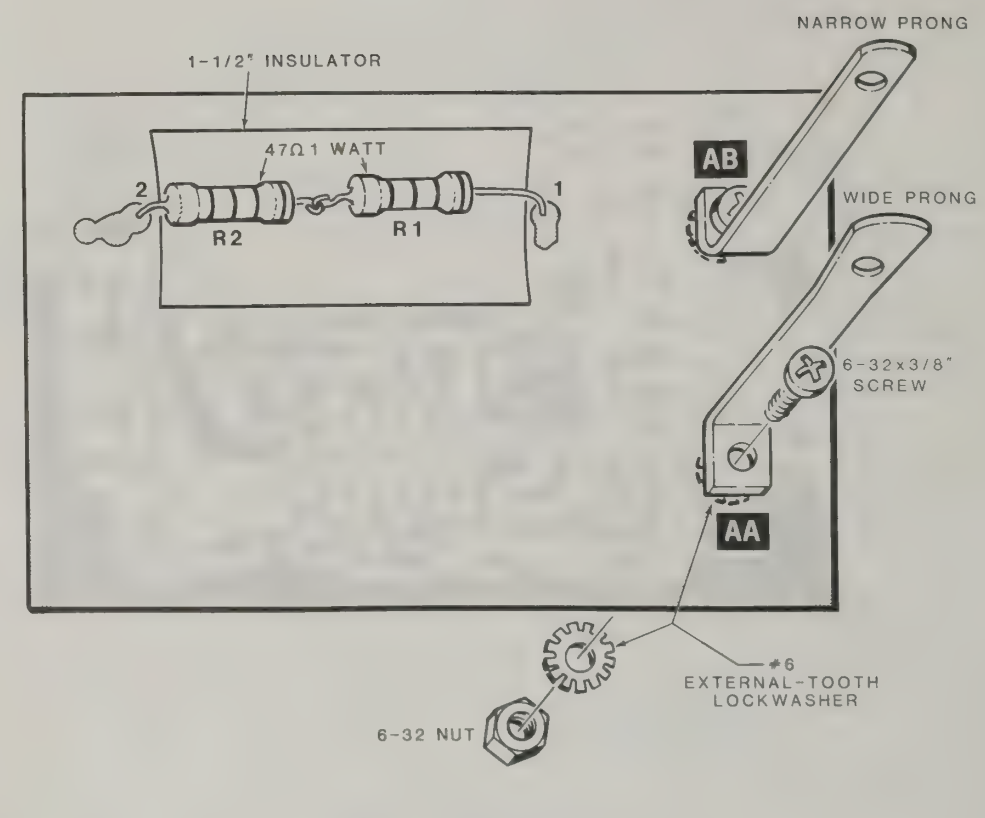
Detail 1-6A



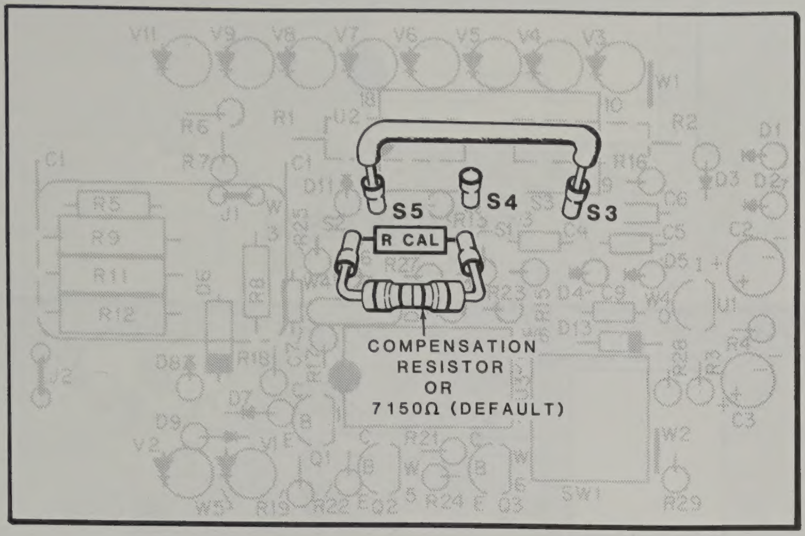
PICTORIAL 1-7



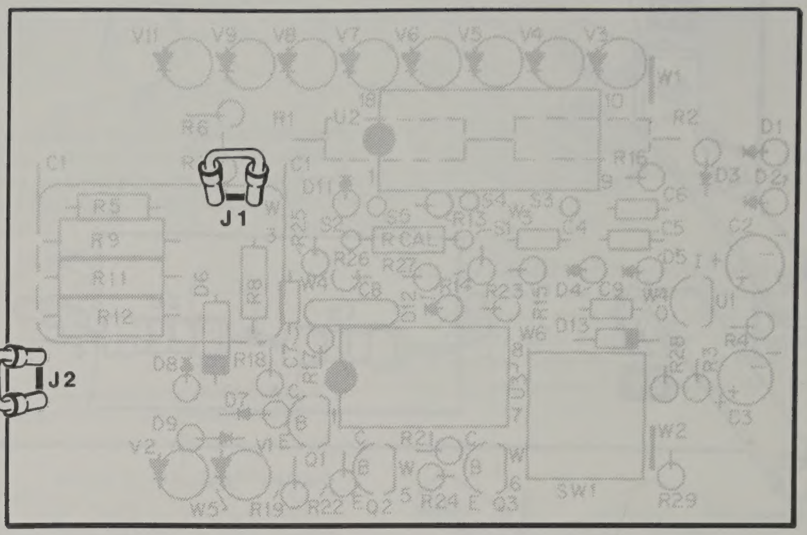
Detail 1-7A



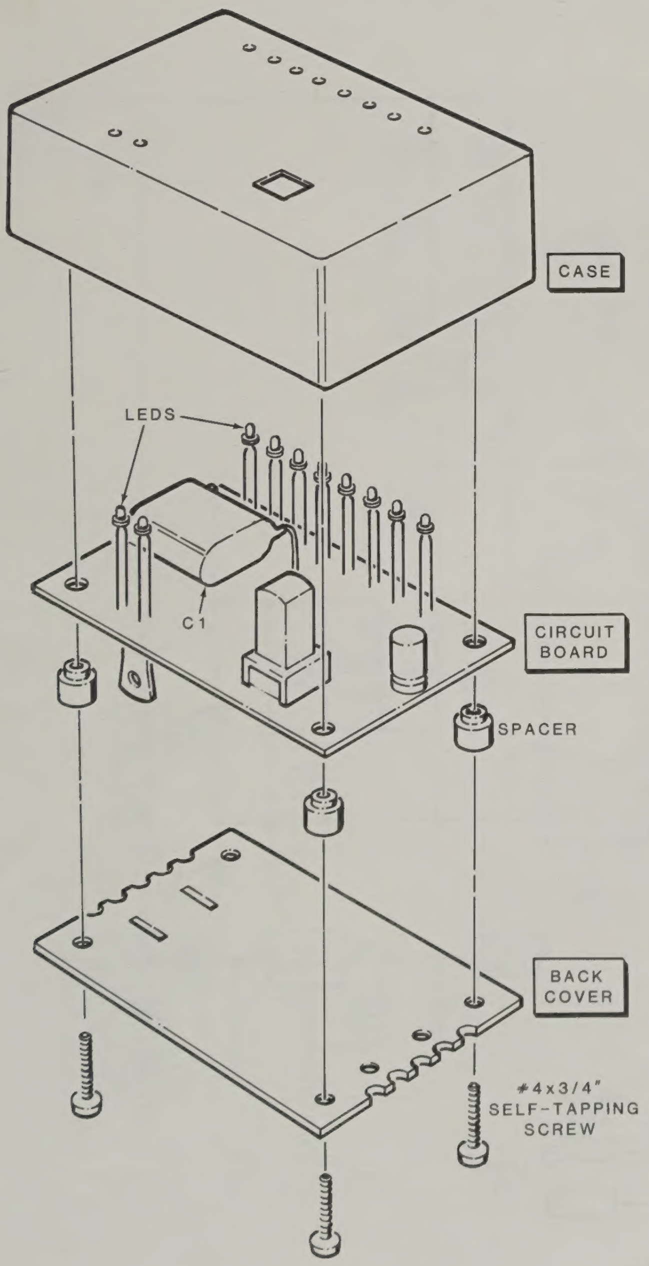
PICTORIAL 1-8



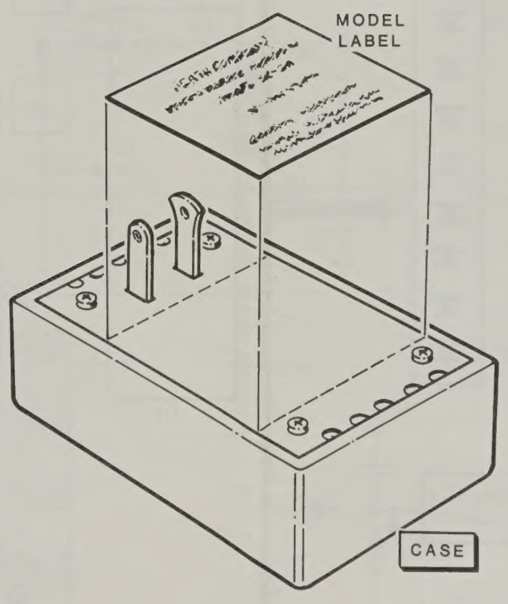
PICTORIAL 2-1



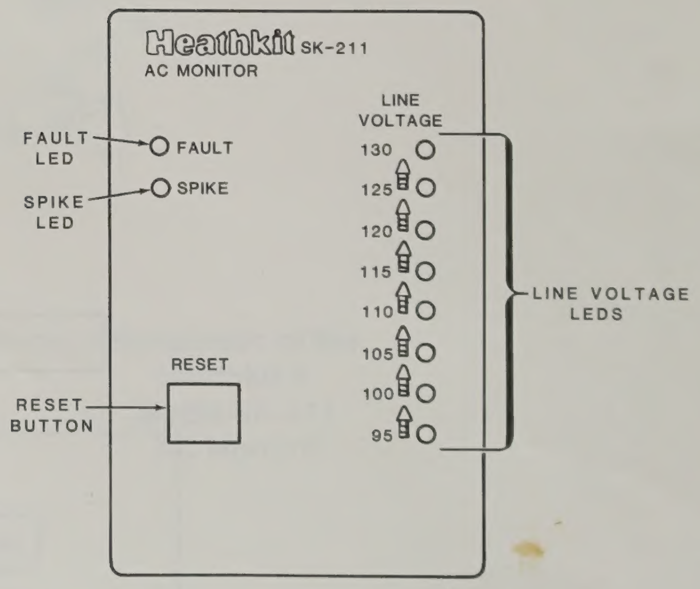
PICTORIAL 2-2



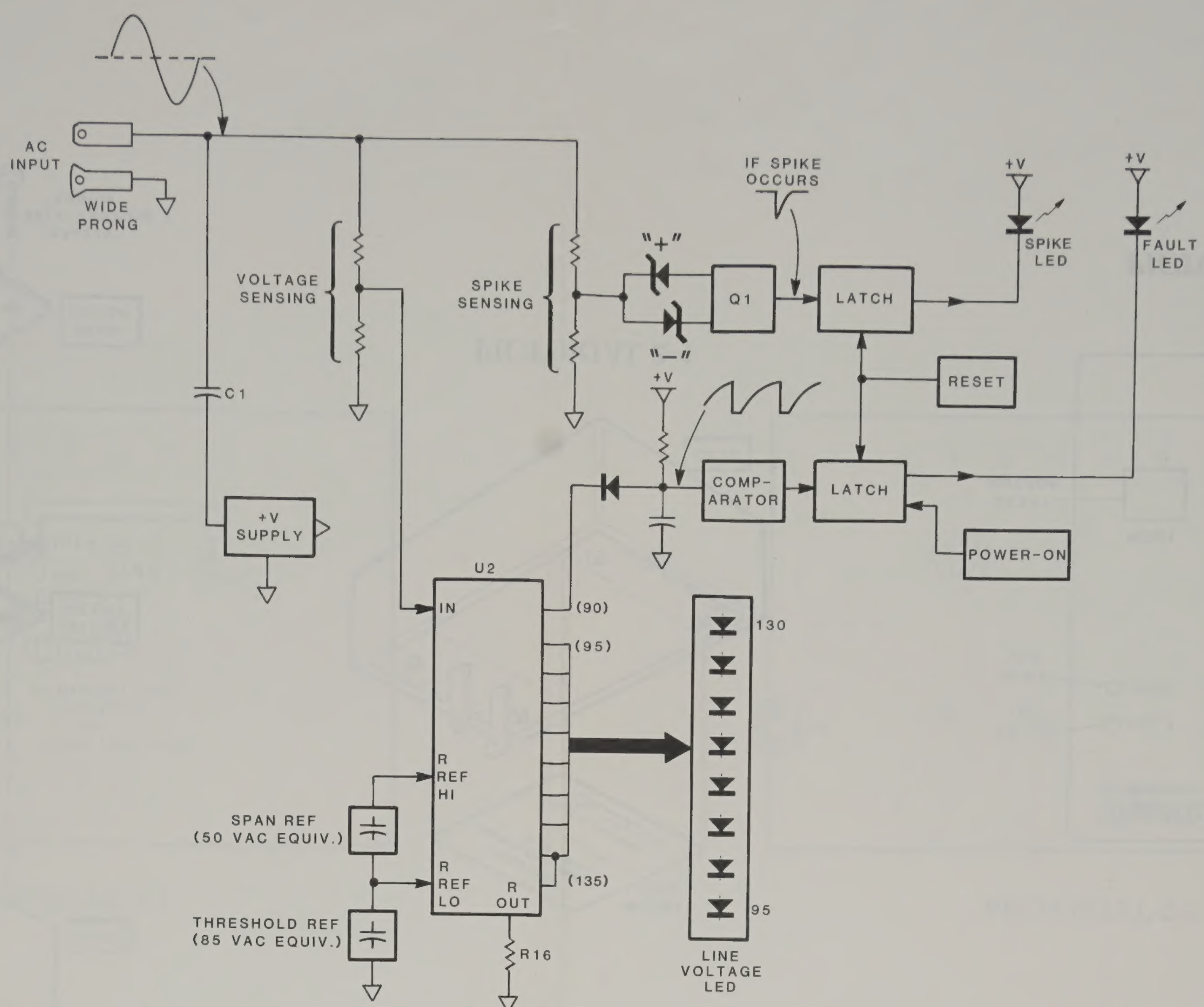
PICTORIAL 2-3



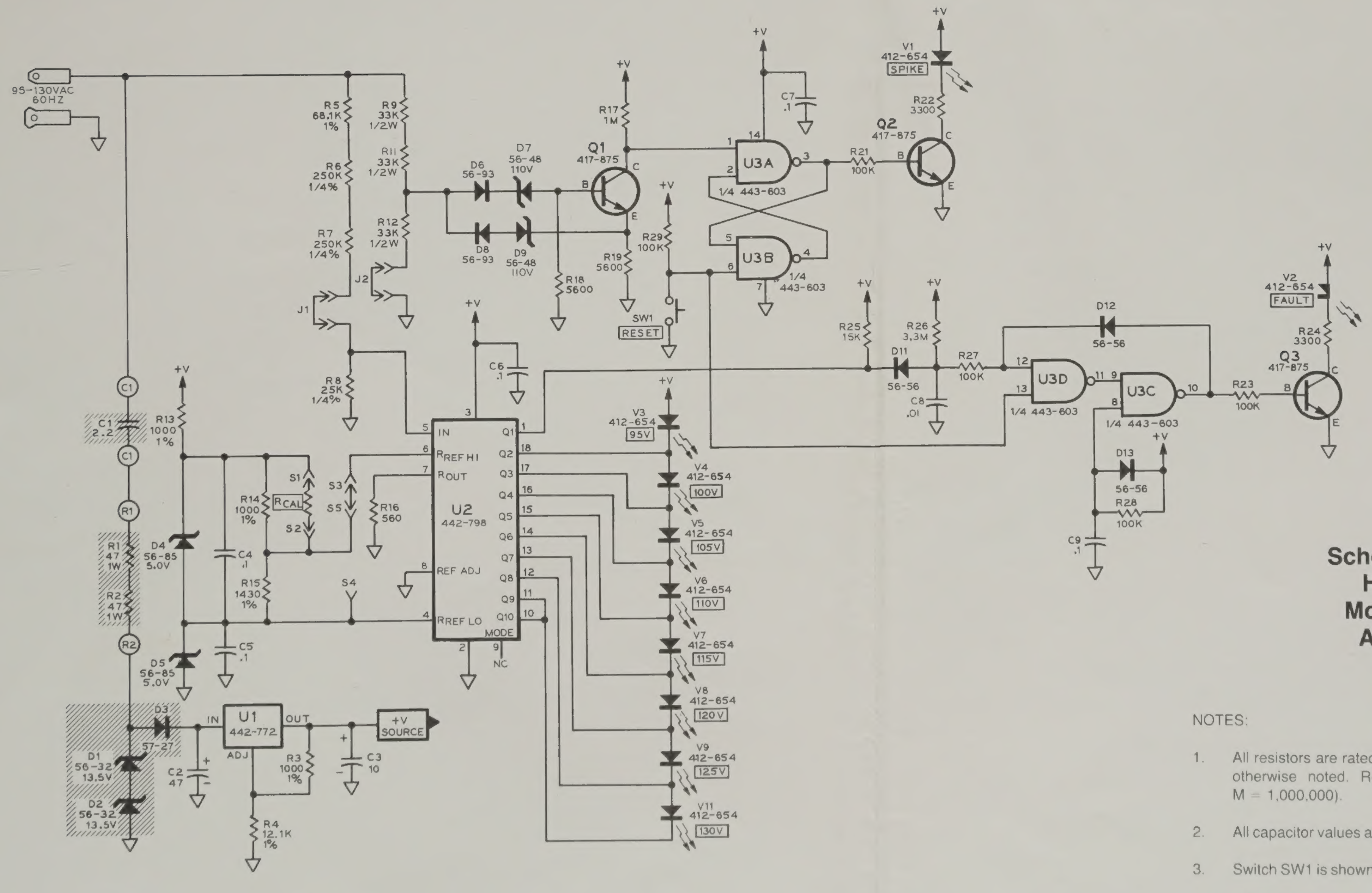
PICTORIAL 2-4



PICTORIAL 3-1



BLOCK DIAGRAM



Schematic of the Heathkit ® Model SK-211 AC Monitor

NOTES:

1. All resistors are rated at 1/4-watt and have a 5% tolerance unless otherwise noted. Resistor values are in ohms (k = 1,000; M = 1,000,000).
2. All capacitor values are in μF (microfarads).
3. Switch SW1 is shown in the released (out) position.
4. ▽ This symbol indicates circuit ground.
5. Refer to the "Circuit Board X-Ray View" for the physical locations of the parts on the circuit board.
6. The parts within the shaded area are critical to product safety. Replace them only with the proper Heath part or the exact equivalent.
7. Refer to "Tests and Calibration" beginning on Page 19 to determine the proper value for R_{CAL}.